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The American Surgeon

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THE
AMERICAN SURGEON

Vol. 22, No. 10 October 1956

THE HOSPITAL HOUSE STAFF: ITS HISTORY, PRESENT DAY SITUATION, AND AN EDUCATIONAL PROGRAM IN A PRIVATE HOSPITAL*

DONALD S. DANIEL, M.D.

Richmond, Va.

Members of the Southeastern Surgical Congress, Distinguished Guests, Ladies and Gentlemen:

Realizing my unworthiness and with a sense of humility, I would like to express my appreciation of the extraordinary honor, which you have bestowed upon me. I shall cherish it as one of my fondest and most flattering memories.

As spokesman of this great surgical organization of 1750 members, and as a citizen of the Commonwealth of Virginia, it is my pleasure to welcome each of you to our historic city. May your visit be both instructive and enjoyable.

The Constitution of the Southeastern Surgical Congress demands that the President deliver an address annually. Therefore, my presence is forced upon you. Since, however, it has become quite popular in the South of late to question the authority and legality of certain interpreteurs of a certain Constitution, I, a believer in States' Rights, have seriously considered the doctrine of nullification or interposition to spare you from this address. Realizing my Constitutional duty, however, I will not interpose, but will endeavor to be as painless as possible.

I invite your attention to the consideration of the Hospital House Staff, its history, its present day situation, the hospitals' shortcomings and moral duty toward the house staff, and expecially to the consideration of an educational program of a rotating internship, which is successfully accomplished in a private optionally-affiliated hospital.

Medical education in America really began shortly after the American Revolution. Before that era it was largely preceptorial. Most of our physicians were either graduates of Continental or English schools. True to the Colonial trend of complete separation from our Mother Country and from our dependence of

* Presidential address presented during the Richmond assembly of The Southeastern Surgical Congress, March 12–15, 1956, Richmond, Va.

foreign medical tutelage, medical schools were started in the following order: University of Pennsylvania 1765; Harvard 1782; Darthmouth and the College of Physicians and Surgeons of New York 1798; and the University of Maryland Medical Department 1807. The value of the young medical graduate's affiliation was first recognized between the University of Pennsylvania and the Pennsylvania Hospital in 1765. It was soon realized that the association between the medical graduate and the hospital was of mutual benefit—a service value to the hospital and an educational value to the recent graduate.

In 1769, Dr. Samuel Bard,[7] when conferring the first medical degree of King's College in New York, made an ardent plea for a general hospital where medical students might be taught. Because of this appeal the New York Hospital was begun on lower Broadway just north of the City Hall, but its doors were not opened until 1791, because of the American Revolution. From its beginning, the medical students and young graduates were taught at the bedside. Later, hospital wards became available for such purposes at Bellevue Prison and Almshouse. Soon the necessity of having a physician reside in these institutions was realized and thus the "*Resident Surgeon*" and the "*Resident Physician*" were born. These titles appear in the roster of the New York Hospital in 1791 and in Bellevue in 1806. This idea also was an emulation of the French and English systems. From the French we derived the word "*interne*", which means that the medical graduate resided in the hospital, and "*externe*", which implies that the house officer has quarters elsewhere.

During the next 75 years there was little change in the opportunities and training of the medical graduates. However, some with more affluence were able to pursue further studies in Berlin, Vienna, Paris, London and especially Edinburgh. Gradually, there appeared in our larger cities almshouses, hospitals and many medical schools of varying characters and questionable curricula, with the consequence that there were many more graduates than hospital positions. Through competitive examinations, only a relatively few of these graduates benefited from hospital training, which consisted mainly of observation, copying didactic lectures, menial care of patients, usually of the institutional type, and dressing wounds. The remainder, the less fortunate, or the more fortunate, scattered throughout our land; obtained a frock coat and a buggy; grew a beard to attain maturity and through dedication, trial and error, became the clinician "*par excellence*", "*The Old Family Doctor*", a figure revered and respected to this day.

At this time, the specialties were of little concern. The three main divisions were medicine, surgery and midwifery. Pasteur and Virchow were soon to appear in the medical drama. The first leg of the tripod of surgery, the control of hemorrhage by ligation, was popularized by Ambrose Paré in the sixteenth Century. Sir Joseph Lister added the second leg, asepsis, and Dr. Crawford Long completed the surgical tripod by the introduction of anesthesia. New vistas were opened; empiricism began to fade under the brilliant lights of scientific truths and the flower of medicine and surgery began to blossom.

The introduction of graded curricula in 1871 by the Harvard Medical School,

and the reception of students at the Johns Hopkins University School of Medicine in 1893, marked the end of the dark age of American medical education. Their leaders with their new ideas, methods, and research pioneered in all fields of medicine, surgery, and medical education. Our entire medical system was permeated by their influence, which has lasted to this day.

The Journal of the American Medical Association published its first Educational Number in 1901,[3] and, in August 1904,[2] the same journal carried an editorial criticizing the haphazard intern system in many hospitals. Only about 50 per cent of the graduates were able to obtain internships. Consequently, the attitude of many hospitals was not altogether altruistic toward the house staff. The hospitals had the buyer's market. Too often the house officers were exploited; educational programs were meager, if at all; housing facilities were inadequate; libraries often were absent and stipends were from zero to minimal. Usually no consideration was given to the intern's leisure for reading and study. Nor was time allotted for culture or self inventory.

The activities of the Council on Medical Education appeared in the Journal of the American Medical Association in 1905. Abraham Flexner's report,[5] "Medical Education in the United States and Canada," in 1910, caused an upheaval and revolution, by describing the deplorable conditions and shortcomings of our many medical schools. In 1914, there appeared the first compilation of hospitals with internships by the American Medical Association.[4] In 1920, for the first time, there was an excess of internships offered over the total number of graduates of that year.

Under the guidance of the American Medical Association, its Council on Medical Education, the American College of Surgeons, and because of the information of the Flexner survey, the standards of our medical schools, hospitals and medical education began to improve immediately. This betterment has continued with the result that today America has the highest type of patient care and medical education in the world. Also, because of recent phenomenal advances in medical science, the awakening of national, state and local health consciousness, the Hill-Burton Act and the concrete expressions of charity reflecting the Good Samaritan, there has been an astounding increase in the number of hospitals in the United States. In spite of this high type of patient care, improved medical education and the large number of recent hospitals, the House Staff situation today has many shortcomings and there is room for improvement in many instances.

Last year (1955) only about 11.5 per cent of 6,970 hospitals in the United States were able to meet the minimal requirements for approval of intern training. According to the National Intern Matching Program,[9] these 814 approved hospitals offered 11,075 internships to 6,713 participating students. Because of this great disparity, only 58 per cent of these positions were filled. There were 4,696 internships left vacant in accredited hospitals. Many of these were filled with externs or foreign interns, a situation far from satisfactory. Consequently, there is a great demand for interns. Today the shoe is on the other foot and the intern has the buyer's market.

This situation has at last awakened the hospitals to realize their obligations to the medical graduate. Two years ago I assembled statistics from the entire graduating class of the Medical College of Virginia concerning their reasons for internship selection.[1] Eighty-five per cent stated that the educational program was their chief reason for their respective selection. Whether the medical profession has recognized it or not, this situation has forcefully brought the hospitals to the realization of the importance of improving the educational program and the other accouterments for the house staff. No longer will the "*laissez-faire*" attitude attract the medical graduate. We must realize that these young men are as dedicated, as we are, or they would not have spent the time, sacrifice, and money to study medicine. They are exceptionally well prepared; they want continued education; and they are thirsty for clinical experience under a kind and sympathetic leadership in an accredited hospital.

Averse as I am to dogmatic statements, I predict that no hospital, be it university or nonuniversity, will survive, if there is not an active, stimulating educational program for the house staff. Medical education is a continuous process. Without it any hospital and its staff will be obsolete in a few years. The educational program is the antibiotic for ailing hospitals. The attending staff should realize that teaching teaches the teacher. It is true that the intern and the residents derive tremendous information and knowledge from the clinical experience of the older staff; it also is true that the recent graduate with his fresh, modern information challenges the attending staff to polish their metal.

Although the title of this address refers to the private hospital, it is only because the great majority of my experience and close relationship with the house staff has been in a private hospital. However, having had experience in both the university and nonuniversity hospitals, I see no reason why this discussion cannot apply to any hospital. The basic philosophy is the same.

Your attention is invited to the consideration of a successful rotating internship, its modus operandi and especially to an educational program of a private optionally-affiliated hospital.

First, however, I would like to state that there are many private and nonuniversity hospitals of 150 beds (the minimal for approval) and over with valuable clinical material, which could be accredited and approved, if only the interest and enthusiasm of the attending staff could be aroused to provide an active, exciting and adequate educational program. This in turn, "*as the night follows the day*", would invariably lead to a more informed staff, a higher standard of practice and consequently a more efficient patient care, our ultimate goal.

Second, in a private hospital, there are many real and special advantages to a house staff. Its relatively smaller size results in a more intimate association between the house staff and the attending staff. This closer relationship actually is a preceptorship, a recognized teaching value in many academic colleges today. The relationship between the general practitioner and the house staff, often unheard of in the university hospitals, also is of value. The diseases of the private or nonuniversity hospitals usually are of the ordinary, every day, "*run*

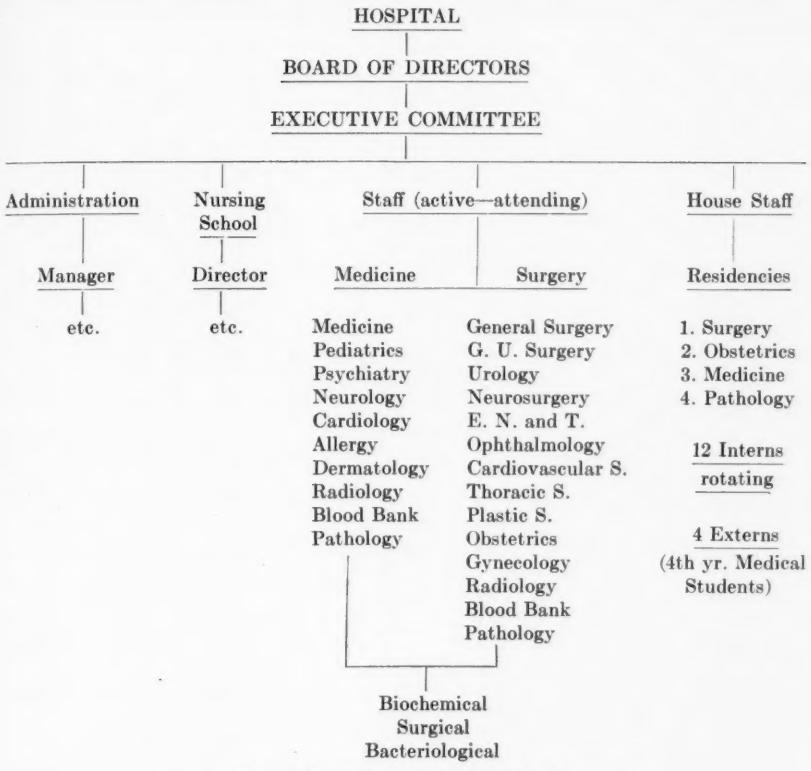

FIG. 1. Departmental division chart

of the mine" type, which have not been screened, as is so often the case in the university hospital. Here the intern may tend to receive a false impression of the incidence of diseases. Moreover, the private hospital house staff acquires that desired manner of attending private patients, which is reflected advantageously in their future practice. Here the patient is treated as well as the disease. Too often in the large hospitals the ideal intern-patient relationship is lost and the patient becomes a formal number or an impersonal interesting pathology.

The Johnston-Willis Hospital of Richmond, Virginia, was founded in 1909 by Doctors George Ben Johnston and A. Murat Willis, two of the outstanding pioneer surgeons of the South. Under the able guidance of their successor, Dr. Frank S. Johns, its President, it has become one of the largest private hospitals in the South. It has 240 beds and 36 bassinets. Last year, 1955, there were 9,240 admissions, 1,400 births, 73,794 patient days and 4,112 operative patients. The attending staff consists of 75 well qualified physicians, 46 of whom are certified board members and the majority of whom are members of the Faculty of the Medical College of Virginia.

Schedule of Rotating Intern Services for Year
Johnston-Willis Hospital, Richmond, Virginia

	Intern	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
1	Name	M	M	M	M	S	S	S	S	E V	E	O	O
2	Name	M	M	M	M	S	S	S	S	E	E V	O	O
3	Name	M	M	M	M	S	S	S	S	O	O	E V	E
4	Name	M	M	M	M	S	S	S	S	O	O	E	E V
5	Name	O	O	E	E V	M	M	M	M	S	S	S	S
6	Name	O	O	E V	E	M	M	M	M	S	S	S	S
7	Name	E	E V	O	O	M	M	M	M	S	S	S	S
8	Name	E V	E	O	O	M	M	M	M	S	S	S	S
9	Name	S	S	S	S	O	O	E	E V	M	M	M	M
10	Name	S	S	S	S	O	O	E V	E	M	M	M	M
11	Name	S	S	S	S	E	E V	O	O	M	M	M	M
12	Name	S	S	S	S	E V	E	O	O	M	M	M	M

Legend: S General surgery and orthopedics
M Medicine, pediatrics and radiology
O Obstetrics
E Elective
V Vacation—2 weeks

FIG. 2. Schedule of intern rotation

This hospital and its house staff program are fully approved by the Council of Medical Education and Hospitals. The hospital also is approved for residencies in Surgery, Medicine, Obstetrics and Gynecology and Pathology (See departmental divisions chart.)

Since we are concerned only with the rotating internship today, the residency programs, their services and responsibilities will not be considered, except to state, that there is no conflict of responsibilities, services or prerogatives between the interns and the residents. In the university hospitals there has developed a serious complaint of the squeeze, in which the intern often finds himself, between the senior medical student clinical clerkship below and the hierarchy of residents above. This complaint usually does not occur in the smaller private hospitals. Our intern-resident relationship has been extremely happy and cooperative.

There are 12 interns, who rotate in the following manner through the various

Division of Services

Johnston-Willis Hospital, Richmond, Virginia

Medicine Chief of Department				*Surgery* Chief of Department				*Ob. & Gyn.* Chief of Department	*Elective Service*
Group 1	Group 2	Group 3	Group 4	Service 1	Service 2	Service 3	Service 4		
Chairman Intern 1 month	*Chairman* Intern 1 month	*Chairman* Intern 1 month	*Chairman* Intern 1 month	*Chief* Intern 1 month	*Chief* Intern 1 month	*Chief* Intern 1 month	*Chief* Intern 1 month	*Chief* 2 Interns 2 months each	2 Interns 2 months each
10 internists and general practitioners	10 internists and general practitioners	10 internists and general practitioners	10 internists and general practitioners				(Orthopedics)	Obstetricians	In any service or specialty of their choice

FIG. 3. Division of services

departments. (See Schedule of Intern Rotation.) During the year each intern spends 4 months on general surgery, including orthopedic, thoracic, cardiovascular, genitourinary, plastic surgery, etc.; 4 months in medicine and pediatrics including radiology; 2 months in obstetrics and gynecology; and 2 months in an elective of his choice. This elective adds flexibility and is an attractive and elastic feature of the program. For instance, the intern may spend 2 months in any speciality, in any affiliated hospital, in anesthesia, pediatrics, pathology, radiology, office practice, or in general practice under a preceptorship, etc. Actually this is only 6 weeks, since the intern is requested to take his 2 weeks vacation during his elective. By taking his vacation at this time the other prearranged schedules will have no interference and the services will not be disrupted.

The remainder of the intern house staff consists of 4 externs, senior medical students, from the Medical College of Virginia. Their duties are to assist the interns and the different services, particularly during stress occasions, such as an unusual number of admissions, sickness or emergency leaves of the interns.

The medical department is divided into four services, each headed by a chairman and consisting of about 10 internists and general practitioners. (See chart.) For 4 months each intern rotates through these medical teams and is responsible for patients from admission to discharge. In this manner, the intern has the advantage of different ideas of diagnosis and therapy, and also, is subjected to a very close relationship with his patients.

Surgery also is divided into four teams: three of general surgery and one of orthopedics. Each has its chief, and the surgical intern rotates for 4 months among each team. Here, also, the intern is responsible to his chief for his patient's care and he always acts as second assistant and sometimes as first assistant in the operating room.

Both the medical and surgical intern serve a period in his respective outpatient department.

There are 2 interns on obstetrics and gynecology. Twice weekly they attend the prenatal and postnatal clinic. During their service, they deliver personally, under the guidance of their chief or the obstetrical resident, about 25 patients, from semi-charity beds provided by the hospital for this purpose.

The entire educational program is under the guidance of the Director of Medical Education. The older members of the attending and active staff enter actively in the teaching program, but the bulk of the instructions are carried on by the younger members of the staff, because they have the energy, the time and, incidentally, are usually better informed.

Besides the services pertinent to the care of their patients, and the daily hospital rounds with their chiefs, there is a coordinated educational program for all interns and residents. This program consists of daily conferences (see chart of educational program conferences and meetings) on one of the following subjects: medicine, surgery, cardiology, pathology, and radiology, Emphasis is placed upon prepared presentation of cases and upon informal discussions with the idea of provoking questions and opinions. Didactic lectures are avoided and the informal conferences are made as stimulating and exciting as possible.

Conference and Meeting Schedule

House Staff

Johnston-Willis Hospital, Richmond, Virginia

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
8 a.m. to 12 noon	Hospital rounds	Hospital rounds	Hospital rounds	Hospital rounds	Hospital rounds	Hospital rounds	Grand rounds
	Operating room	Operating room	Operating room	Operating room	Operating room	Operating room	
12 noon to 1 p.m.	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch
1 p.m. to 4 p.m.	Floor service	Floor service	Floor service	Floor service	Floor service	Floor service	Floor service
4 p.m. to 5 p.m.	Medical conference	Surgical conference	Cardiology and E. K.G. review	Pathology review conference	Radiology review conference		
5 p.m. to 6 p.m.	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner
7:30 p.m.			Weekly journal club Monthly staff meeting Monthly C.P.C.				

FIG. 4. Conferences and meeting schedule

In addition to the above, there are weekly Journal Club meetings, monthly Staff meetings and clinical pathological conferences. At the yearly House Staff Reunion, a distinguished guest is invited to deliver the A. Murat Willis Memorial Oration, a feature of the graduate training. For instance, a few of the past orators:

1952, Dr. Paul D. White, Boston.
1953, Dr. Evarts A. Graham, St. Louis.
1954, Professor Philip R. Allison, Oxford, England.
1955, Professor Charles F. W. Illingworth, Glascow, Scotland.

The continuation of the basic sciences is most important in the educational program, however, it should be clinical and not didactic. Formal courses and preclinical laboratories are not necessary. It is desirable and necessary, however, to apply clinically the previously learned anatomy, bacteriology, pathology, biochemistry, pharmachology, and physiology.

Anatomy is taught at the examining and operating tables. The participation of the house staff in the autopsies is not only informative pathologically, but also anatomically. Gross and microscopic anatomy may be learned from fresh laboratory specimens.

Qualified personnel in adequate biochemic and bacteriologic laboratories guide the graduate in diagnostic procedures.

Gross and microscopic pathology receive a most important emphasis. Weekly conferences, under the tutelage of a competent pathologist, are most valuable. Current pathologic slides, from patients familiar to the house staff, are projected upon a large screen, are analyzed, explained, and discussed by all.

Due consideration is given to the maintenance and remuneration of the house staff to allow them to live in comfort and in the dignity of their station. No longer will certain hospitals, because of their former reputation, be able to exploit interns with a mere token stipend. It has been estimated that a medical education costs about thirty thousand dollars. Four years of high school, four years of college, four years of medicine and four years of postgraduate training—

"Sixteen years and what does he get?
An education, a family and deeper in debt.
Oh, St. Peter, don't you call him no more;
He owes his soul to the banker's store."

(My apologies to Tennessee Ernie Ford.)

The governing body should always remember the valuable services the interns are rendering the hospital and its patients, and, therefore, they should render Caesar his dues.

Although due consideration is given to vacation and off-hours, the house staff is not pampered, but is impressed with the fact that the medical profession is one of service; that physicians should not practice by the clock; and that emergencies and occasions may require a 24 hour duty day with no coffee breaks.

One of the vital secrets of a successful internship program is the proper relationship between the attending staff and the house staff. In the beginning, the house staff should understand that there are certain duties, which they

must perform. Their respect and confidence should be obtained by our actions and our interest. They should be treated as our professional and social equals. In this manner, a happy relationship will be attained, which will not only be beneficial to the two staffs, but also to the hospital and its patients.

To teach the young by precept and example is one of the greatest moral dictates of human life. Teaching approaches immortality and eternity, because the pupil in turn teaches, and so on "*ad infinitum*". Teaching is our duty, and, if we are not dedicated to instructing the medical graduate, we are guilty of professional parental delinquency. With our aid and sympathetic guidance, these young medical graduates may attain even greater accomplishments, and, like the Chambered Nautilus,[6] leave their low vaulted past and build more stately mansions, each nobler than the last.

Finally, because of our interest, encouragement, and instructions, the house staff, armed with knowledge, truth, confidence, and faith, will not be afraid to walk alone, or in any company; and they may well say as Sidney Lanier,[8] our beloved southeastern poet, said,

> "Behold, I will build me a nest on the greatness of God:
> I will fly in the greatness of God as the marsh-hen flies
> In the freedom, that fills all the space 'twist the marsh
> and the skies."

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COMPARISON OF RADICAL AND LESS EXTENSIVE SURGERY IN CANCER OF THE BREAST

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Variability in the virulence of cancers of the breast must be considered in assessing therapeutic procedures. Some tumors grow very slowly, while others more rapidly overcome the defenses of the patient. There are tumors that metastasize early throughout the blood or lymph circulation and are soon fatal; in others, detached cells either die, or lie dormant for many years, only to flourish later. The time of recurrence after radical mastectomy illustrates the variability of this delay. The limit of recurrence usually is taken as 5 years, and patients who survive longer are considered free of disease. It must be admitted, however, that there are patients in whom recurrence becomes apparent only after 10, 15 or even 20 years following primary surgery. What is the biochemistry of the body that holds the cancer cells in a dormant condition for such long periods?

It must be confessed that years ago I was convinced that while a cancer might enlarge locally, its first and only channel of spread was lymphatic to the axillary nodes. Now, I am aware that while this is an important channel of spread, there are many other lymph channels, frequently leading to inoperable conditions. What is still unknown, however, is the incidence of lymphatic spread outside the radical operative field, the significance of axillary metastases as an index of spread, and the incidence of spread by the blood stream (estimated to occur, according to some reports, in as many as 20 per cent of all cases).

Dahl-Iversen[4] is of the opinion that gross invasion of the supraclavicular nodes is an indication of inoperability. His inquiring mind has speculated on the incidence of microscopic invasion of the supraclavicular nodes and its relation to operability. Therefore, along with radical mastectomy, he performed a radical dissection of the neck on the same side in 47 Group I patients, and 40 Group II patients. In 1949, he reported that in none of the Group I patients was there any microscopic node invasion, but that invasion did occur in 11 of the Group II patients, or 28 per cent. As a result, Dahl-Iversen decided that he would thereafter include supraclavicular dissection in all patients with palpable axillary lymph nodes, until he had at least a 5-year follow-up on a sufficient number to determine the results on Group II patients.

Handley and Thackray,[6] as well as Dahl-Iversen,[4] have recently reported a fairly high frequency of invasion of the internal mammary lymph nodes from cancer of the breast. This is especially likely to occur, they believe, when the axillary nodes have been invaded or when the tumor lies in the central or medial half of the breast. Their observation is now generally accepted.

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As a result of the re-emphasis on the significant microscopic spread of breast cancer to the supraclavicular and internal mammary nodes, some question as to the role of radical mastectomy in the treatment of breast cancer has been raised. Previously, radical mastectomy had been accepted for many years as an excellent procedure, supplemented by many surgeons, with high voltage x-ray therapy to the axilla, supraclavicular region, and mediastinum. However, during the past 10 or 15 years, this method of treatment has been challenged in two directions. One group believes that the Halsted procedure is not extensive enough, while others maintain that this procedure is needlessly extensive, and even harmful. So, where does this leave us?

Let us first consider what the advocates of super-radical surgery have to say. They maintain that in cases of carcinoma of the breast, there is a high incidence of metastases to the axilla, the neck, and the mediastinum. Because they have little, if any, faith in x-ray therapy, they regard the danger of metastases as an indication for complete surgical clearance of the internal mammary and supraclavicular nodes, as a supplement to the Halsted radical operation. It is fair to state that with current aids to surgery, such as anesthesia, antibiotics, and blood replacement, this combined procedure can be carried out with decreasing mortality, although it does carry an added operative risk.

Difficulties also arise from the anatomic relations. Stibbe[9] and Sorensen[8] have shown that the number and location of the internal mammary nodes are variable, and that there are numerous communications among *them*, and with the thoracic duct on the same side and the opposite side. It therefore is extremely difficult to effect removal of the nodes, particularly in comparison with the relative ease of axillary or supraclavicular dissection.

Further, 5 year follow-up results are not yet available for patients who have had this super-radical surgery. In the meantime, I shall be so bold as to state my opinion that these metastases to the supraclavicular and internal mammary nodes are an indication of inoperability.

The second criticism of the Halsted procedure is exemplified by the Edinburgh School, led by McWhirter[7], an enthusiastic x-ray therapist. He accepts the reports of Dahl-Iversen and Richard Handley as to the frequent invasion of the axillary, supraclavicular, and mediastinal areas, but strongly believes that he can sterilize these nodes with x-ray therapy. He admits defeat, however, with primary tumors of the breast, and therefore asks his surgical colleagues to do a *very* simple mastectomy before referring the patient to his clinic. He has used a minimum tumor dose of 3750 R., and from his latest reports, he appears to be increasing the dosage.

McWhirter was in New York not too long ago, at which time I had the pleasure of meeting and talking with him. I suggested that better results could be obtained by his form of x-ray therapy if preceded by a radical mastectomy. He replied that it would be impossible to get good results by this method as the residual skin flaps would be too thin to take his heavy dosage; furthermore, he believes that cancer is disseminated by massage in the course of surgical dissection of the axilla.

There is one observation I would like to make in reference to the simple mastectomy advocated by the surgeons (about 40) who do this operation for McWhirter. As far as I can determine, their procedure is performed for practically all tumors, large or small, with or without axillary metastases. McWhirter himself believes that it is not much more than a local excision of a tumor. This means that in many of the treated patients, the surgeon must cut through and leave cancer cells in the remaining breast tissue and chest wall. As evidence to support this assumption, I offer the report I made in 1946[10] on local recurrence after inadequate radical mastectomies. Ackerman[1] also reports, as late as 1955, that he found evidence of a high incidence of local recurrence in the Edinburgh series.

As far as we now know, x-ray therapy has never been proved sufficient to destroy the axillary lymph node metastases. Adair[2] deals with this problem in his study of 1936. In the few patients of the Edinburgh series, in which axillary nodes were subsequently removed, viable cancer cells were found where a sufficient time interval had elapsed.[1] Nevertheless, it is fair to state that x-ray therapy does reduce the blood supply to the nodes by fibrosis, and thus may slow up the cancer growth, for a while, at any rate.

It is generally accepted that when cancer is still localized, it can be cured by simple mastectomy. In fact, in those cases of radical mastectomy, in which no axillary metastases can be found in the tissues, results might be just as successful with simple mastectomy and without x-ray therapy. However, it is impossible to know the condition of the axilla until after the tissue has been studied. McWhirter can never tell us, therefore, in how many of his patients the axilla was free of metastases. When we examine a cancer of the breast that appears to be operable, we may assume that the tumor is confined to the breast because no axillary nodes are palpable. That such a premise is unsound, however, is proved by the subsequent finding of axillary metastases in a definite percentage of these patients. It seems to me that although palpable axillary nodes do not always prove to be metastatic, the safest policy would be to clean out the axilla completely in all patients, as first suggested by Halsted. For the surgeon, this is a very satisfactory procedure, as recurrence in the axilla is very rare. McWhirter's objection seems to me more theory than fact, although I will concede that when there is a massive invasion of the axilla, the process of removing the growth may be accompanied by massage.

Shall we rest content, however, with the poor results that we get from radical mastectomy? For when the axillary nodes are involved, this procedure yields only a 30 to 40 per cent survival after 5 years. We must face the fact that cancer is beyond the Halsted field in the majority of patients (60 to 70 per cent) because of lymphatic or blood stream dissemination. It is obvious that the spread by way of the blood stream (estimated at 25 per cent) is for the present beyond surgery, or x-ray control. That leaves about 35 per cent of patients, as a guess, in whom the spread into the pleura, mediastinum, neck, spine or viscera occurs through the lymphatics. Advocacy of super-radical surgery is based on the belief that metastases beyond the Halsted field are confined to the neck and internal

mammary chain. Let us hope that this approach may have some justification in results.

There is another limitation in the use of the Halsted procedure that should be mentioned. Haagensen and Stout have demonstrated that many patients with cancer of the breast are in an inoperable state at the time of first examination. These authors[5] have presented a list of conditions, or combination of conditions, in which the patient will not benefit from surgery. While one may take exception to some of the listed conditions as being too absolute, these two men have made a great contribution in making the medical profession aware of the futility of many operations. Renewed emphasis in the literature of recent years, on the spread of cancer to the supraclavicular and internal mammary nodes, also has compelled us to realize the limitations of the Halsted operation.

The use of high voltage x-ray therapy following mastectomy has been advocated by many, and the method of use has undergone many modifications in the past 40 years. Radiologists have felt dissatisfied with results, as shown by the increasing use of higher voltages and heavier dosages. In spite of its limitations, however, there is no doubt that x-ray therapy has definitely helped in prolonging life.

I would like to present my experience with 290 cases of radical mastectomy and to compare the results with those of McWhirter.[7] Comparison is difficult, or well nigh impossible, because McWhirter gives only a clinical evaluation and not a pathologic report of the condition of the axillary nodes. He reports that in 1063 patients, whom he considered operable, there was a crude 5 year survival rate of 58 per cent, but he does not mention whether there were evidences of recurrence in any survivors. These are remarkably good results, however, in view of his statement that all patients were followed.

In my series, radical mastectomy was done by me, or by my resident with me in attendance. No patient was lost to follow-up. All deaths were considered due to cancer, so that there are no indeterminants.

From table I, you will see that our total 5 year survival rate is 53 per cent, which is statistically equivalent to the 58 per cent reported by McWhirter. Among our 290 patients, 153 had axillary metastases. Only 48 of these, or 31

TABLE I

Five year follow-up of cancer of the breast treated by radical mastectomy

Patients treated at Roosevelt Hospital

Diagnosis	Total Cases	Alive After Five Years	
		Number	Per cent
With axillary metastases	153	48	31
Without axillary metastases	134	107	80
Total	287*	155	53

* There were 3 operative deaths among 290 patients in the series. All deaths occurring within the 5-year period are recorded as due to cancer.

TABLE II

Site of local recurrences of cancer of the breast

Patients treated at Roosevelt Hospital

Diagnosis	Skin	Parasternal Area		Subtotal	Tota
		Inner half	Outer half		
With axillary metastases	28	3	4	7	35
Without axillary metastases	2	6	1	7	9
Total	30	9	5	14	44

per cent, were still alive at the end of the 5 year period, as may be seen in table II. In 134 of our patients who were free from axillary metastases, 107, or 80 per cent, were still alive at the end of the 5-year period.

Upon comparison of these two groups, the conclusion seems inescapable that survival is closely correlated with the occurrence of axillary metastases, since only 31 per cent survived when metastases occurred, while 80 per cent were still alive at the end of 5 years when metastases were absent.

In my experience as a surgeon, I have been accustomed to doing a radical mastectomy in as thorough a manner as I know how. I have been fortunate in being able to follow all my patients and to observe the progress of their disease.

I now believe that many patients in this series were incurable when first seen, and should not have been operated upon except for palliation. However, my criteria are not as rigid as those of Stout and Haagensen because of the occasional brilliant recovery after surgery on patients that they would have classified as inoperable.

I also am aware that when the axillary nodes are involved, there is a good probability of spread beyond the operative field. As a guess, I would say that this applies to 60 per cent of patients with axillary node involvement, for in these, we only salvage 30 to 40 per cent of the patients through the use of surgery.

To justify his super-radical surgery, Dahl-Iversen[4] stated that x-ray therapy is of no value. I would like to believe that he will later need to reverse himself, for *I* would say that x-ray therapy to the mediastinum and supraclavicular are as is better than super-radical surgery.

McWhirter[7] stated that "when the disease is no longer confined to the breast, it is still desirable to remove the breast, wherever possible, for it is in the breast that recurrence is most likely to take place."

I would comment that if the breast and the axillary nodes are involved and a radical breast operation is performed, recurrence is more likely to occur beyond the operative field.

In spite of the apparent similar 5 year survival rates between the reports of McWhirter and myself, I still believe that the radical Halsted procedure is preferable to McWhirter's method. With radical mastectomy we are more certain of removing the cancer, thus giving greater assurance of prolonged life.

SUMMARY

In summary, I would like to repeat my main conclusions, which are as follows:

Super-radical surgery requires greater operative risk than the other methods discussed, and is not based on clear-cut anatomic and pathologic considerations.

Simple mastectomy, as advocated by McWhirter, involves a high risk of persistence of carcinoma in the axillary nodes and in the operative field.

Radical mastectomy of the Halsted type is the procedure that I prefer, and I have had good experience with it on patients in whom axillary metastases did not occur. However, there undoubtedly is still need for improvement in the treatment of patients *with* axillary metastases, who appear for surgical aid.

In addition to surgery, aid for these patients may take the form of x-ray therapy, hormonal gland excision, testosterone therapy, or perhaps one of the new chemical compounds.

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FIVE YEAR END RESULTS IN THE TREATMENT OF INGUINAL HERNIA

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An accurate evaluation of operations for the correction of inguinal hernia has been difficult because of the paucity of reports dealing with 5 to 10 year end results. It had been generally believed that most recurrences after herniorrhaphy will occur within 1 to 2 years of the operation and that 2 year follow-up reports can give an accurate appraisal of the procedure. But recent observers, notably Clear[2], Kilbourne,[8] Hagen and Rhoads,[6] as well as Mayo and Keeley,[12] have indicated that a mere 2 to 3 year follow-up will fail to demonstrate a true recurrence rate, and that *at least* a 5 year period of observation is necessary for complete evaluation.

In recent years also, interest in the problem of inguinal hernia has been greatly stimulated by the careful anatomic studies of Anson and McVay,[1] published in 1938, in which the insertion of the transversalis fascia into Cooper's ligament rather than the inguinal ligament was particularly emphasized, and the suggestion was made that, in operations for the cure of inguinal hernia, Cooper's ligament rather then the inguinal ligament should be used.

Since 1942, we have been employing a Cooper's ligament repair in the large majority of operations for inguinal hernia. It has seemed of interest, therefore, to investigate and report the end results obtained with this technic 5 or more years after operation.

OPERATIVE TECHNIC

In large part, sharp dissection is used. The principles must be observed of gentle handling of tissues; careful hemostasis with fine-pointed Halsted or modified Rankin clamps; only small bits of tissue included in ligatures—which should be nonabsorbable, preferably no. 000 cotton or silk—and the use of interrupted sutures of similar material.

The skin incision is made parallel or slightly oblique to the inguinal ligament 1½ to 2 cm. medial to it. The lower end should expose the pubic tubercle (spine). The external oblique is divided in the line of its fibres at the middle of the bulge of the inguinal canal or at the level of the middle of the external ring. The ilioinguinal nerve is recognized and retracted with the medial leaf of the external oblique or with the cord (fig. 1). The medial leaf of the external oblique is freed bluntly from the cord, from the internal oblique, and from the rectus muscle up to its fusion with the internal oblique, to form the medial half of the anterior sheath of the rectus. The lateral leaf of the external oblique is freed from the cord down to and exposing the inguinal ligament.

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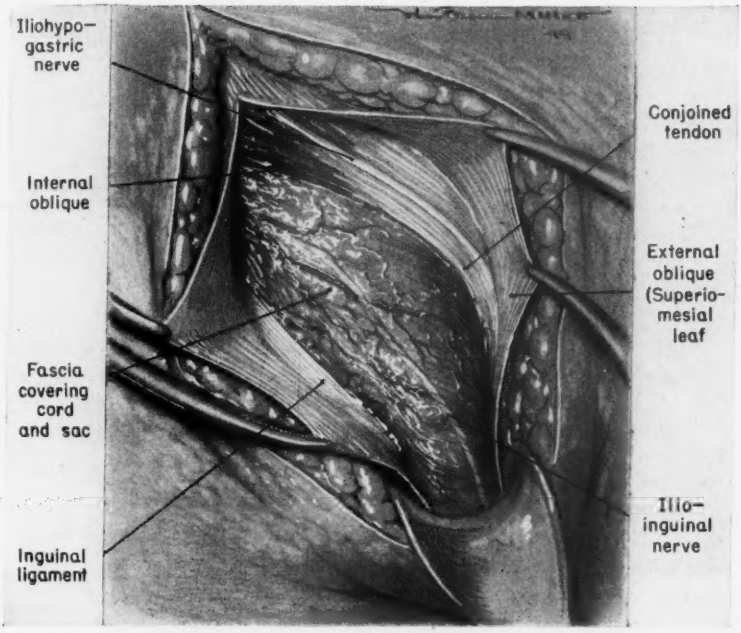

FIG. 1. The external oblique has been split in the line of its fibres. The cord with the ilioinguinal nerve lying upon it is exposed. The aponeurosis of the external oblique has been freed medially to its fusion with the internal oblique and laterally to the inguinal ligament. The location of the iliohypogastric nerve is indicated.

The cord is raised—the posterior anastomotic vein is recognized if present and resected and the pubic tubercle is well exposed as well as the deep insertion of the transversalis. Any defects in the transversalis fascia are noted. Any direct hernia is recognized (fig. 2). If the cord is thick, the cremaster and any lipoma or excessive fat are separated and resected. The cord is freed from all muscle or areolar attachment up to the internal ring.

Here, the peritoneum usually can be identified, near the neck of any indirect sac. The sac is incised and explored. The lower abdomen and femoral canal are palpated; any concomitant femoral hernia is dealt with, since a Cooper's ligament repair will close the femoral canal as well. The sac is freed from the cord by traction and sharp dissection, ligated *high* at its neck and resected. With high ligation, the stump of the peritoneum will retract well up—2 to 3 cm. beneath the transversalis and internal oblique. When a direct hernia is present with an indirect, by traction on the neck of the sac, a pantaloon type of double hernia protrusion can be united into a single sac before resection.

On the right side, if the appendix is low and easily palpated on exploration, appendectomy may be considered when no contraindication exists, but should never be done when repair of the inguinal canal promises to be difficult or pro-

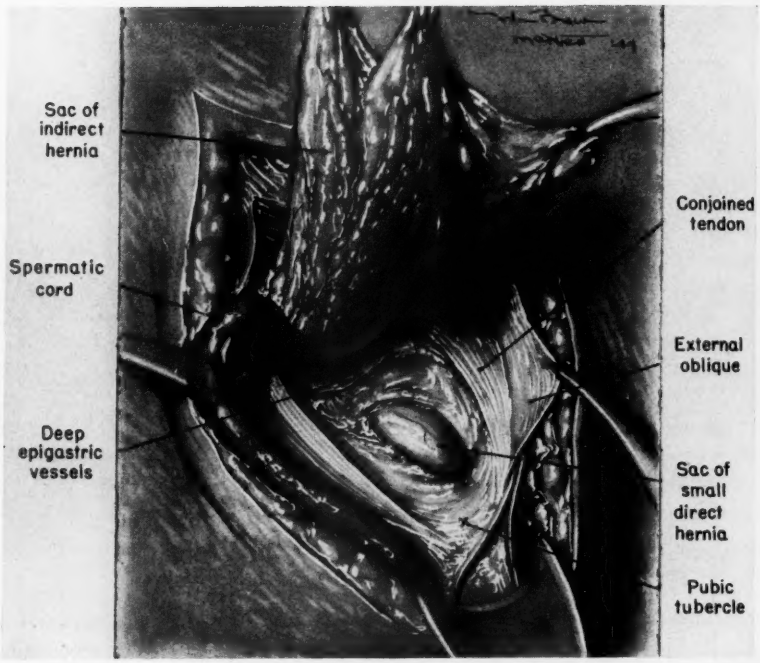

FIG. 2. The cord has been freed and retracted. The sac with some fat attached has been freed from the cord up to the internal ring. The pubic tubercle has been exposed as well as the protrusion of a small direct hernia through the transversalis fascia.

longation of the operation seems unwise. Appendectomy for a normal appendix that might jeopardize careful asepsis is never justified.

When no indirect sac is present, the peritoneum is freed from the cord at the internal ring and allowed to retreat into the abdomen.

Repair of the Inguinal Canal: The cord is retracted out of the wound laterally. The transversalis fascia is carefully observed for any weakness or openings or defects. Any direct hernia is completely freed, restored to the abdomen and the opening in the transversalis closed by suture (fig. 3, 4). Any other defects in the transversalis then are closed by interrupted cotton or silk sutures. Rarely will resection of a sac be necessary in a direct hernia. If the internal ring is large, it is closed by suture of its margins, snugly around the cord, leaving an opening that just admits the tip of the index finger (fig. 5). Too tight closure of the internal ring may lead to atrophy of the testicle. The area just cephalad to the pubic tubercle is a frequent location of a direct hernia and must be particularly checked for any weakness and strengthened by suture when indicated.

The second step in closure of the inguinal canal is suture of the conjoined tendon (the sharp lateral edge of the rectus sheath and muscle) to either the inguinal or Cooper's ligament—or this maneuver may be modified by splitting the sheath of the rectus about 1 cm. medial to its lateral margin (fig. 7) and suturing both

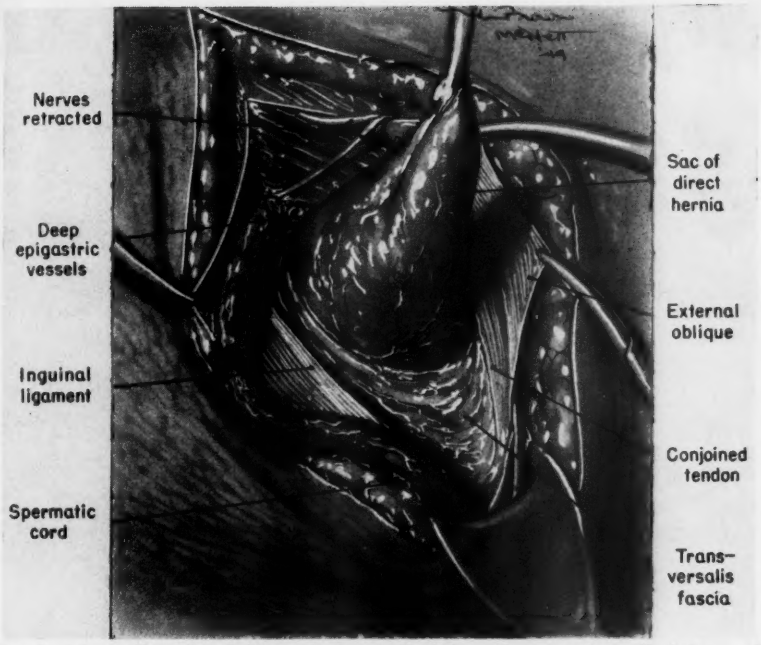

FIG. 3. A large direct hernia through almost all of the entire posterior wall of the canal

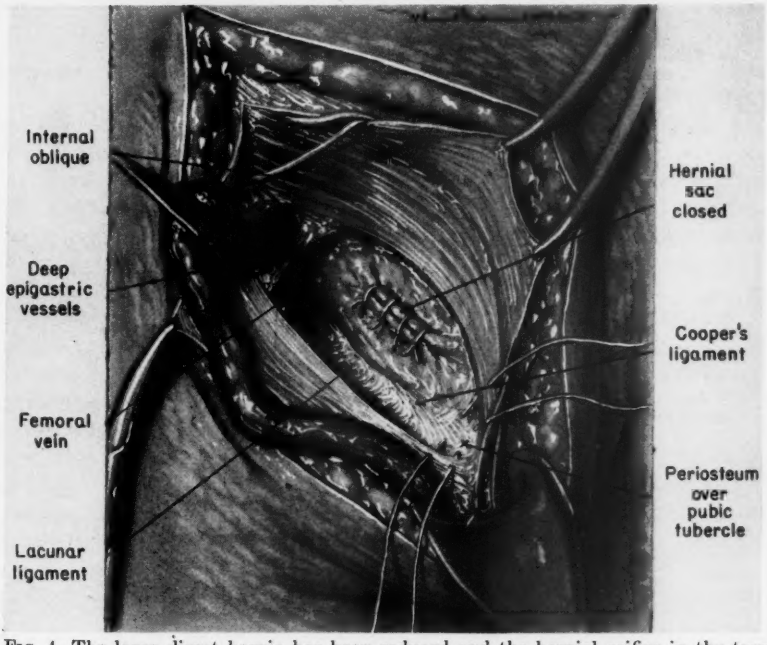

FIG. 4. The large direct hernia has been reduced and the hernial orifice in the transversalis fascia has been closed by interrupted sutures (cotton). The first sutures inserted in the conjoined tendon. Cooper's ligament and the inquinal ligament are shown.

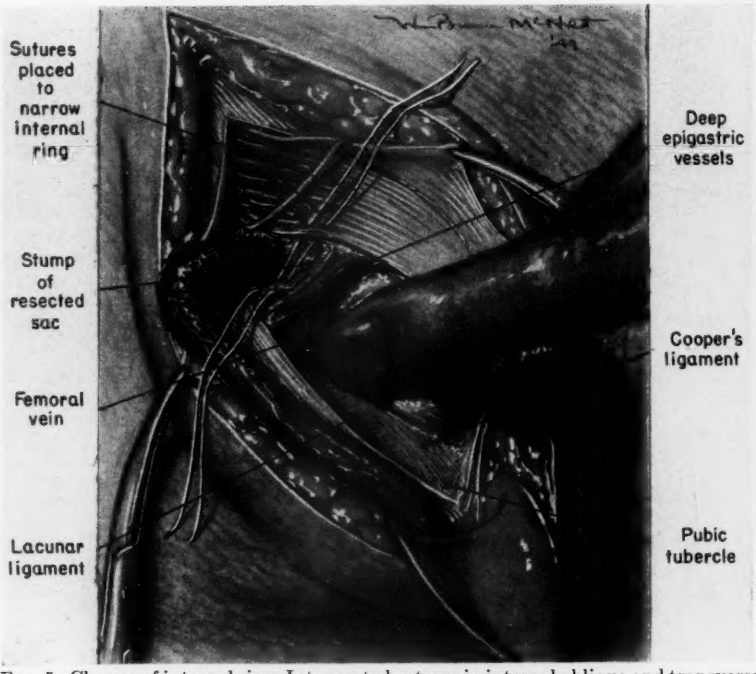

FIG. 5. Closure of internal ring. Interrupted sutures in internal oblique and transversalis inserted snugly but not to cause constriction of cord.

FIG. 6. Alternate method. The 3 sutures on the right pass through conjoined tendon. Cooper's ligament and inguinal ligament up to the femoral vessels. The sutures on the left indicate that sutures lateral to the femoral vessels are inserted through conjoined tendon and the inguinal ligament only.

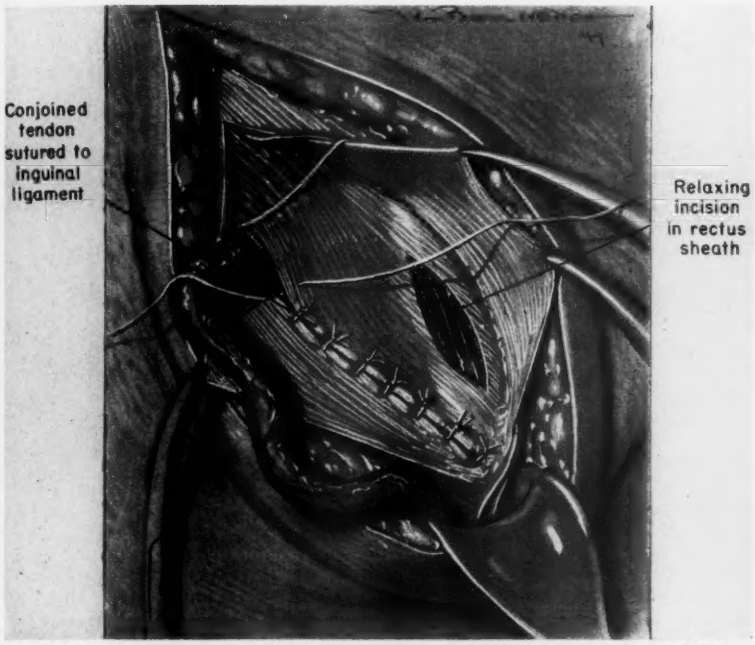

FIG. 6 (a). **Alternate method. Conjoined tendon sutured directly to Cooper's ligament and the inguinal ligament sutures tied. Incision in rectus sheath to relax tension is shown.**

the tendinous margin of the rectus muscle and the lateral leaf of its sheath to either the inguinal or Cooper's ligament.

In the operation to be reported, we have used suture of the tendinous margin of the rectus and its sheath to both Cooper's and the inguinal ligaments, (fig. 4) because, if Cooper's ligament alone is used, when the sutures are tied, occasionally there seems to be a small dead space between the inguinal ligament and the rectus muscle. However, when the distance between the conjoined tendon and Cooper's ligament is not too great, the sheath is not split and the conjoined tendon is sutured directly to Cooper's ligament and the inguinal ligament with the customary relaxing incision in the rectus sheath, 2 to 3 cm. medial to its lateral margin (fig. 6 and 6(a)). In most cases but 2 to 3 sutures spaced about 1 to 1½ cm. apart can be inserted in Cooper's ligament before it passes beneath the femoral vessels (figs. 8, 9). Before inserting any sutures in Cooper's ligament, the location of the femoral vessels must be ascertained and injury to them must be avoided at all costs. Sutures through Cooper's ligament should be inserted parallel with the femoral vessels. The index finger of the left hand can be kept on the vessels to identify them and insure their protection during insertion of sutures, and all sutures should be inserted or placed before tying any (figs. 9, 10). When sutures in Cooper's ligament have been inserted and tied, this layer of sutures is completed in the lateral half of the canal by suturing the rectus sheath and muscle or conjoined tendon to the inguinal ligament up to the level of the

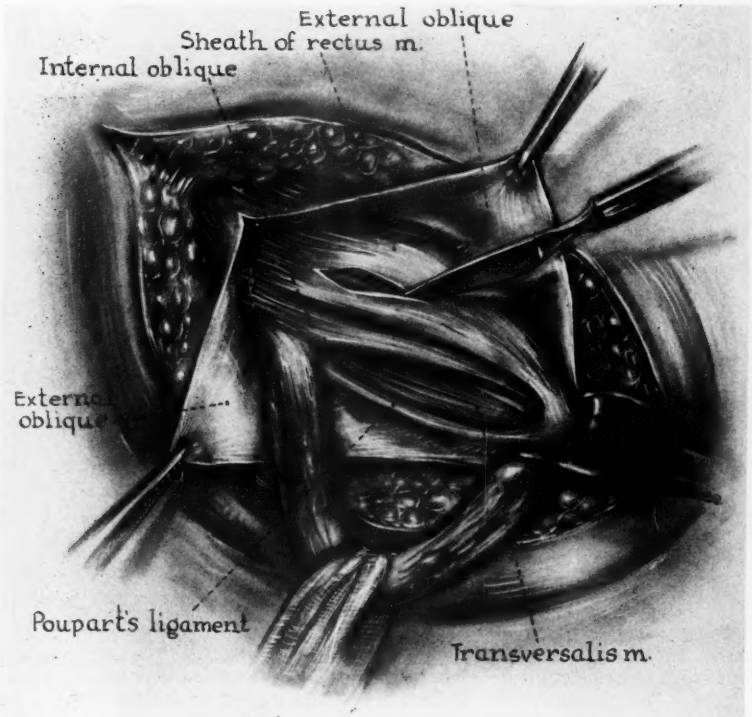

FIG. 7. The sheath of the rectus is incised 1 centimeter from the lateral margin from the level of the internal ring to the pubic spine, eliptical incision.

internal ring. The internal oblique usually is included in the last suture but again care must be taken not to close the internal ring too tightly about the cord (fig. 11).

The third step in closure of the canal is to suture—over the first layer just described—the lateral leaf of the external oblique to the medial margin of the sheath of the rectus, overlapping the edges whenever possible. With this completed, a new double floor of the inguinal canal has been created, largely of fascia, with *nonsuperimposed suture lines* (fig. 12).

In the fourth and final step, the cord is dropped back into the wound upon the new floor of the canal and the medial leaf of the external oblique is sutured over the cord to the anterior surface of the inguinal ligament or the external oblique close to it, forming a new roof to the canal and a new external ring (fig. 13).

Finally, the deep layer of the superficial fascia is approximated by fine interrupted cotton sutures and the skin with interrupted silk vertical mattress sutures.

Spinal anesthesia is preferred.

POSTOPERATIVE THERAPY

The patient is out of bed the day following operation and ambulant, and leaves the hospital in 5 to 9 days, depending upon his age and the character of the closure required. Those of sedentary occupation are allowed back at work in 3 to 4 weeks and those doing moderate or heavy labor in 3 to 4 months with no restrictions—except in old age—on the type of work, but a gradual return to full duty is advised.

END RESULTS

Up to Jan. 1, 1951, there have been 418 patients operated upon by the above technic, 292 (70 per cent) of whom, with 363 hernias, have been followed 5 or more years. Patients returning for check-up have all been examined personally.

280 hernias have been followed	5–6 years
13 hernias have been followed	7 years
16 hernias have been followed	8 years
8 hernias have been followed	9 years
8 hernias have been followed	10 years
13 hernias have been followed	11 years
10 hernias have been followed	12 years
15 hernias have been followed	13 years plus
363	

Of 363 total hernias reviewed 5 or more years after operation, 93 (25 per cent) have been observed and checked 7 to 15 years postoperatively. There was no postoperative mortality.

AGE INCIDENCE

Age	Number
18–30	68
30–40	76
40–50	100
50–60	111
60–70	51
over 70	12
	418

It will be observed that 211 patients (50 per cent) were between the ages of 40 and 60, and 63 (15 per cent) were over 60 years.

No patient under 18 years of age, and no women, have been included in this study. A Cooper's ligament repair is not indicated in infants and adolescents. Simple resection of the sac, with or without a Bassini type of closure, should suffice in these early years. The patients who could not be traced fell largely in the younger age groups—below 40 years.

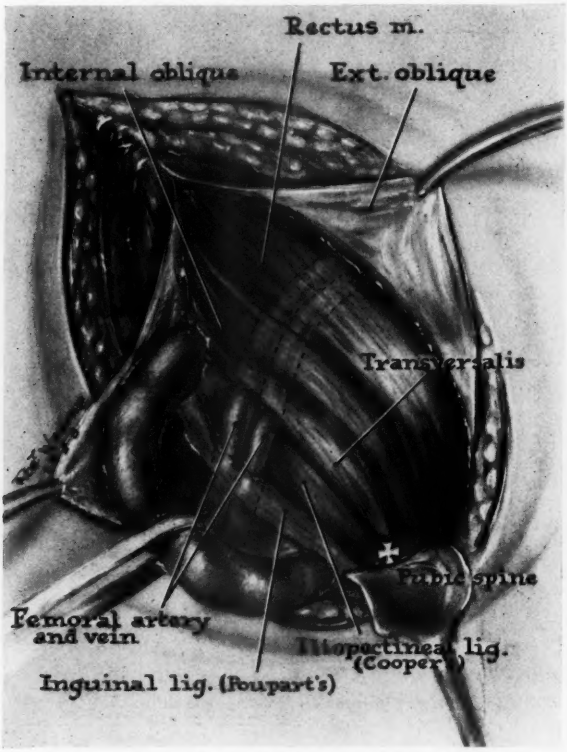

FIG. 8. Position of femoral vessels in relation to structures of inguinal canal. Distance from pubic tubercle (spine) to femoral vessels is indicated.

FOLLOW-UP REPORT

Hernia Type		No.	Recurrence	Recurrence Percentage	Complications	
Indirect		230	2	0.87	Atrophy of testicle	2
Sliding	30				Hydrocele	1
					Infection	2
Direct		113	2	1.77	Atrophy of testicle	1
Recurrent		20	1	5	Hydrocele	1
Total		363	5	1.5	Atrophy of testicle	3
					Hydrocele	2
					Infection	2

Bilateral 71

COMMENT

Sliding Hernia: Included in the 230 indirect hernias were 30 of the sliding type. These were treated in general quite similarly to a direct hernia—completely freed and reduced and the large internal ring closed by suture snugly around the

FIG. 9. Finger protecting femoral vessels during insertion of sutures through Cooper's ligament.

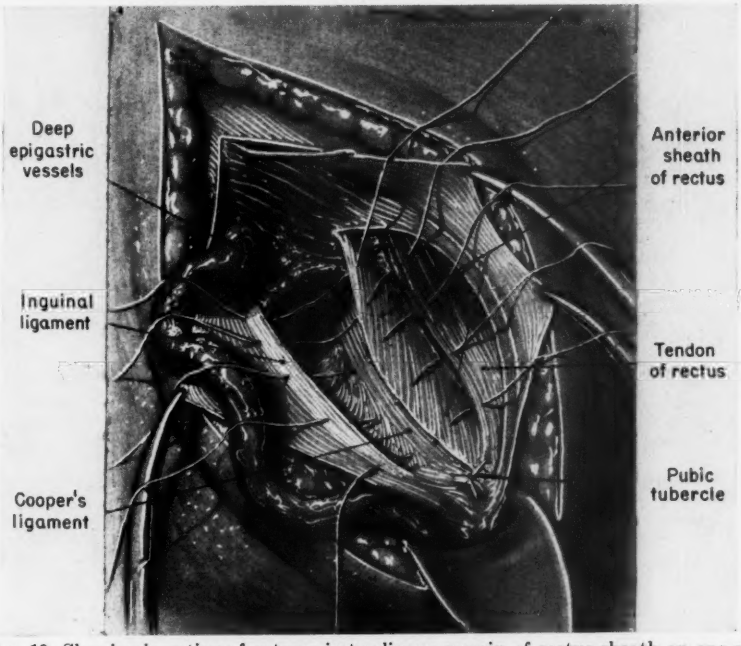

FIG. 10. Showing insertion of sutures in tendinous margin of rectus sheath on one side of the canal and through Cooper's ligament and the inguinal ligament on the other up to the femoral vessels and then lateral to them through the rectus sheath and muscle and through the inguinal ligament only.

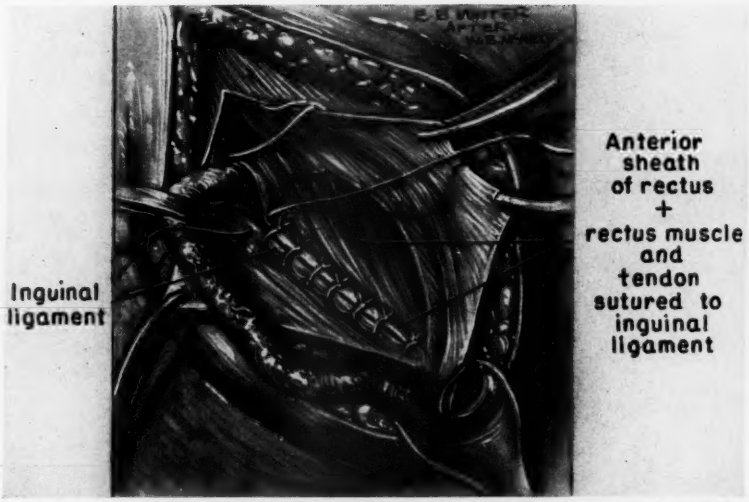

FIG. 11. Sutures through rectus muscle, rectus sheath, Cooper's ligament and the inguinal ligament are tied. Sutures are shown in figures 10 and 7.

Internal oblique
External oblique (Inferio–lateral leaf) sutured to cut edge of rectus sheath
Site of row of deep sutures

FIG. 12. Lateral leaf of fascia of external oblique has been sutured to medial leaf of sheath over the deeper layer of repair shown in figures 10 and 11. Note nonsuperimposed suture line the 2 layers of closure.

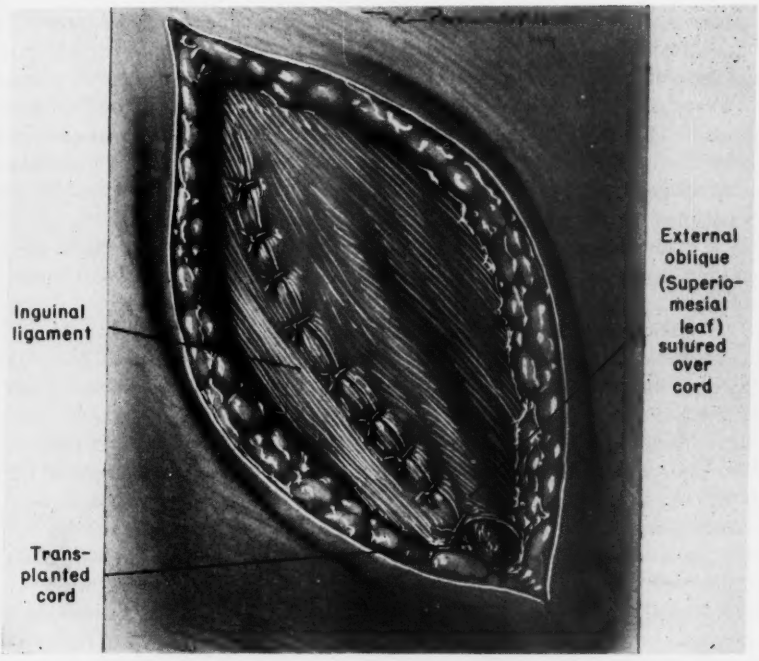

FIG. 13. Cord has been dropped back into wound over lateral leaf of external oblique shown sutured to rectus sheath in figure 12 and the medial leaf of external oblique aponeurosis has been sutured over the cord to the anterior surface of inguinal ligament.

cord. In no patient was an abdominal approach necessary or indicated. Occasionally, the peritoneum was incised to explore the lower abdomen, and, in large hernias, one or more layers of inversion sutures were inserted in any remaining bulge through the ring to act as a buttress to keep the protrusion from interfering with the operative closure. There have been no recurrences in this group.

Bilateral Hernia: Of the 71 bilateral hernias, all but 1 were repaired at the same operation. In this case, the indication for operation on but one side at a time was a chronic cough in a plethoric, hypertensive, rather obese patient with a large protruding abdomen. The second hernia was repaired 3 weeks later. Bilaterality itself has not been considered a contraindication to simultaneous repair in this series.

Complications: Atrophy of the testicle was observed in 3 patients, all apparently due to tight pressure against the cord at the level of the internal ring by the insertion of sutures too close to the cord, which, when tied, had caused constriction of the cord structures. Sharp angulation of the cord at the level of the internal ring also may cause pressure sufficient to produce slow atrophy of the testicle. While this would seem avoidable, an occasional instance of testicular atrophy will be likely to be discovered with careful re-examination. But very

few testicles will be found completely atrophic. An incidence of less than 1 per cent would not seem to be prohibitive.

The development of an occasional case of hydrocele following herniorrhaphy is not a rarity and presents no problem in treatment, but the repair of a hydrocele at the time of a herniorrhaphy has been followed, in one patient, by testicular atrophy. Simultaneous operation for hernia and hydrocele must be undertaken with meticulous care to control all bleeding in and about the cord and testicle, with particular care to avoid a too tight new internal ring.

The 2 cases of postoperative infection were not complete suppuration of the wound but small, superficial, local abscesses about superficial ligatures or sutures. Infection in one of these patients seemed to contribute to recurrence.

In one patient, there was swelling and edema, moderate in type, of the entire right lower extremity, beginning 2 days after operation. It was not accompanied by fever; there was no evidence of superficial or deep phlebitis. The swelling completely subsided in 3 weeks and has not recurred. We believe this was due to a suture being inserted through Cooper's ligament too close to the femoral vein.

Recurrence Rate: In this series, there was an over-all recurrence rate of 1.5 to 36.6 per cent of the total hernias were either direct in type or recurrent. Inasmuch as in all reports of end results, direct and recurrent hernia repairs have a higher percentage of recurrence than repair of an indirect hernia, any series of patients in which there is a high proportion of direct and recurrent hernias, will show a higher over-all percentage of recurrence than those in which indirect hernia predominates.

Location of Recurrence: All recurrent hernias were of the direct type; one through an orifice in the lateral third of the posterior wall of the canal, and three just cephalad to the pubic tubercle, a well-known area of potential weakness, and one showed recurrence of a breakdown of the entire posterior wall of the canal, in which there seemed, at operation, a complete absence of the transversalis. There was such a wide space between Cooper's ligament and the conjoined tendon that there was considerable tension on the suture line when the sutures, inserted between the rectus sheath and muscle and Cooper's and the inguinal ligaments, were tightened.

Cause of Recurrence: Infection of the wound, with sequestration of sutures and ligatures, occurred in one hernia that recurred at 40 years of age.

In another, a left-sided hernia, operated upon at the same time as the right side, developed a small direct hernia of which the patient was not aware. The right side had been repaired first so that *tension* on the suture line in *bilateral, simultaneous operation* may have been an etiologic factor (the patient was 53 years old).

Tension on the *suture line* was certainly present in the recurrent hernia that recurred (the patient was 64 years old.)

In the fourth patient, a sudden jar of increased abdominal tension, by his foot slipping from the pedal, when attempting to start a motorcycle, seemed to be a precipitating factor in a 45 year old policeman.

In one patient, 55 years of age, no definite cause for recurrence could be determined.

Time of Recurrence: Of our 5 recurrences, 2 occurred in the 1 to 2 year postoperative period; one, 3 years postoperatively; one at 3½ years; and one, discovered at the 5 year examination, was accompanied by no symptoms and of which the patient was quite unaware.

There were no recurrences found in the 93 patients observed for more than 5 years.

It would seem therefore, to obtain an accurate estimate of the effectiveness of a herniorrhaphy, patients should be followed for at least 5 years and checked by actual re-examination and not merely by letter.

DISCUSSION

In 1941, we reported a rectus sheath-inguinal ligament herniorraphy from which end results had seemed most satisfactory; the recurrence rate was 1.4 per cent. Our Cooper's ligament repair is a modification of that operation. In 1950, we recorded a preliminary observation of 5 year end results of this Cooper's ligament technic. This present report confirms our earlier findings of a satisfactory low recurrence rate following its use.

Both Orr[13] and Mattson[11] have suggested a similar use of Cooper's ligament except that, after suturing the conjoined tendon to Cooper's ligament, the sheath of the rectus is sutured to the inguinal ligament as a separate layer.

Mattson[11] cites an experience with 323 patients in whom there were four recurrences—recurrence rate was 1.24 per cent—discovered by a 3 year follow-up, largely by letter.

In other reports of Cooper's ligament repair, Harkins[7] has recorded 435 cases with 5 recurrences (1.15 per cent); Rains,[16] 115 with 4; (3.4 per cent) and McVay[10] 60 with none. However, with the exception of some of McVay's patients, none had been followed 5 years, and most reports were obtained by letter. Zimmerman,[17] however, does not favor the use of Cooper's ligament for repair of the inguinal canal, because of the technical difficulties and the danger of injury to the femoral vein. Certainly, the surgeon who would use a Cooper's ligament repair should master any technical difficulties. A method whereby injury to the femoral vein may be avoided has already been indicated.

Recent end results, concerning operations other than Cooper's ligament repair show the following pattern:

McArthur repair (pedicled fascia sutures)

Name	Type	No.	Recurrence	Recurrence Rate	Follow-up
C. W. Mayo and Keeley[12]	unilateral	155	6	11.9%	By letter
	bilateral	34		13%	

Modified Halsted repair

Name	Type	No.	Recurrence	Recurrence Rate	Follow-up
Palumbo, Paul and Emery[14]	indirect	385	6	1.5%	By letter
	direct	114	1	.09%	Length of follow-up, 1–4 years
	combined	136	0	.0	
	sliding	7	0	.0	
	Total	642	7	1.14%	

Bassini, Halsted and McVey repairs

Name	Type	No.	Recurrence	Recurrence Rate
Glenn[5]	indirect	770	19	3.1%
	direct	205	18	8.2%
	recurrent	95	14	14.7%
	Total	1070	51	4.7%

Name	Operation	Indirect	Direct	Recurrent	Over-all Recurrence Rate
Hagan and Rhoads[6]	Halsted	347	173	59	
	Bassini	233	38	11	
	Ferguson	102	2	1	
	McVay	10	5	4	6.1%
Recurrence rate		4%	5%	21%	

Good 5 to 10-year follow-up.

It would seem, therefore, that Cooper's ligament repair end results compare favorably with those obtained by other methods.

SUMMARY

While this series of cases concerns but 363 hernias, it would seem sufficiently large, with a 5 year follow-up, from which to draw an adequate conclusion as to its efficiency. It is *not* to be understood that this operation is advocated *exclusively* for inguinal herniorrhaphy. Obviously that type of repair of the inguinal canal should be used which promises to be most effective in view of the actual defects found in each individual case.

Particularly an inguinal ligament repair, or a modified Halsted procedure, has definite indications, especially when the distance between Cooper's ligament and the conjoined tendon is so great that there is too great tension on sutures that attempt to approximate these structures, and when the need for exceptional strengthening of the area of the posterior wall of the inguinal canal cephalad to the pubic spine is obvious.

CONCLUSIONS

A Cooper's ligament repair has a definite place, and probably is the operation of choice, in the repair of many inguinal hernias. If it is accurately used in properly selected cases, it will be attended by a satisfactorily low rate of recurrence.

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ADENOMATOUS POLYPS OF THE LARGE BOWEL; THEIR SIGNIFICANCE TO THE SURGEON

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The importance of recognizing and treating polyps of the colon is based on the frequency with which they occur and the cancer potential they represent. From the reports of many investigators,[5, 9, 10, 11, 12] the evidence becomes more and more convincing that a colon in which polyps are prone to form is a colon in which cancer is likely to develop. The detection of these polyps offers the practicing surgeon an unusual opportunity to treat cancer by prophylaxis, or to eradicate it by a very simple procedure in its earliest stages.

This paper will review in particular the diagnostic measures and the surgical approach that we have employed at the Roosevelt Hospital for the treatment of large bowel polyps. A discussion of congenital familial polyposis will not be included here. It should be noted, however, that this condition can be passed along to the offspring of either sex, and that if untreated, a very high percentage (36 per cent) of the patients may develop cancer of the colon.[1]

INCIDENCE AND DISTRIBUTION

Polyps of the large bowel are common and may be expected to occur, as Swinton[10] indicates, in 7 per cent of routine autopsies. The location of these polyps, as reported in the 1,843 consecutive autopsies in his series, would suggest that they may be found more or less equally distributed throughout the entire colon and rectum.

It seems important to emphasize Swinton's findings, as there are repeated statements in reports by others that benign polyps are located preponderantly in the rectum (80 per cent), and next most commonly in the sigmoid colon. Our findings at the Roosevelt Hospital during the past 5 years (table 1) show that although his autopsy findings may reflect the true state of affairs, we still are unable to diagnose and locate more than 20 per cent above the sigmoid colon. In this period of time we have removed 313 polyps from 181 patients and have found 80 per cent to be located in the sigmoid and rectum. However, Swinton's autopsy findings do create the provocative thought that improvements in x-ray technic may give us a method that will eventually approach the effectiveness of the sigmoidoscope; and that polyps in the colon will be discovered, which in the past would have remained undetected. Our experience also indicated that at least 25 per cent of our patients had more than one polyp (table 2). This observation is similar to that of others[10], whose autopsy studies revealed that polyps

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TABLE 1

Adenomatous polyps of the large bowel
Roosevelt Hospital 1951–55 (inclusive)

Sites from which 313 polyps were removed in 181 patients	
Rectum	74 (34.4%)
Sigmoid	98 (45.5%)
Descending colon	23 (10.6%)
Transverse colon	10 (4.6%)
Ascending colon	6 (2.7%)
Cecum	4 (1.8%)
Total	215*

* This total gives the number of times that these sites were involved in 181 patients; it does not reflect the total number of polyps removed from each site.

TABLE 2

Anaplasia and multiplicity of adenomatour polyps of the large bowel in 181 patients
Roosevelt Hospital 1951–55 (inclusive)

Patients with malignant or anaplastic polyps	76 (41%)
Patients with multiple polyps	46 (25%)

TABLE 3

Adenomatous polyps and carcinoma of large bowel in 181 patients
Roosevelt Hospital 1951–55 (inclusive)

Polyps associated with a frank carcinoma		
Benign polyps	25 (68%)	
Malignant or anaplastic polyps	12 (32%)	
		37 (20%)
Polyps not associated with a frank carcinoma		
Benign polyps	80 (59%)	
Malignant or anaplastic polyps	64 (41%)	
		144 (80%)
Total		181 (100%)

were multiple in 42 per cent, while in clinical studies they were multiple in 27 per cent of the patients.

ETIOLOGY

Inflammatory polyps are in some cases associated with infectious lesions of the colon, such as are seen in advanced stages of ulcerative colitis. However, very little is known about the etiology of the more common benign adenomatous polyp.

It is doubtful that inflammatory polyps ever become malignant, but we know that adenomatous polyps do undergo a malignant change and this is a reality which we must accept. The relative frequency with which frank cancer of the

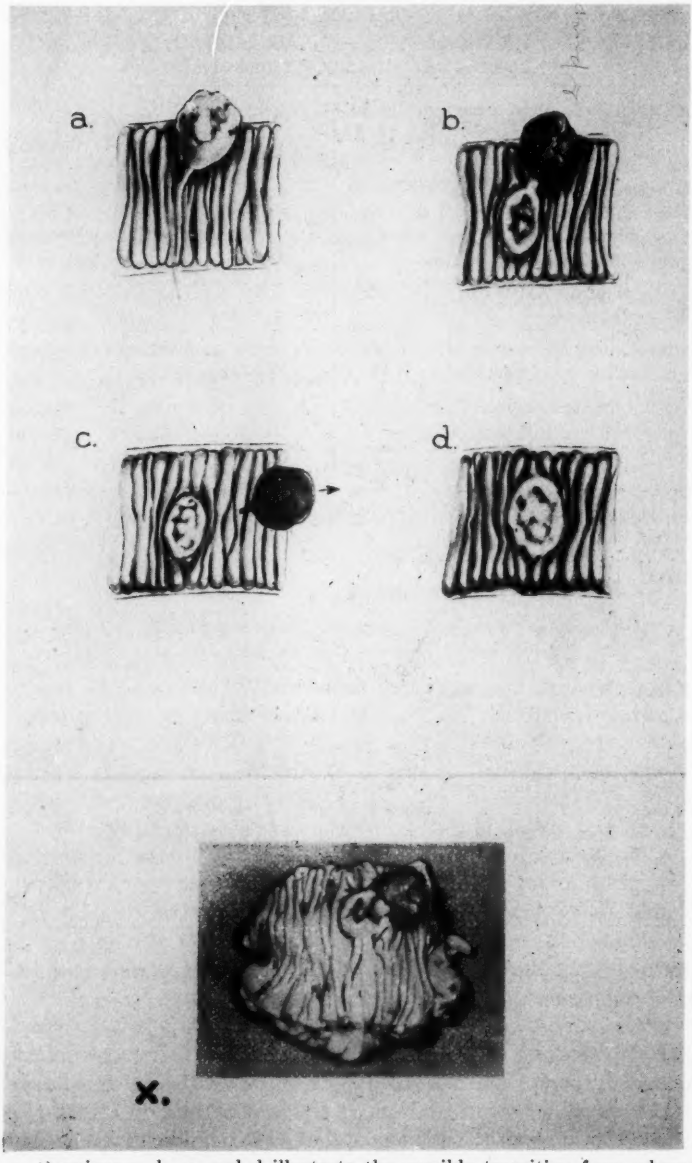


FIG. 1. Drawings a, b, c, and d illustrate the possible transition from adenomatous polyp to frank carcinoma. Peripheral anaplasia in polyp "a", progresses to invasion of stalk and surrounding mucosa in "b". The drawing "b" has been reproduced from an actual photograph "x". The embarrassment of circulation to the main body of the polyp as noted in "b", results in sloughing at the level of the pedicle, as shown in "c". Drawing "d" represents the frank carcinoma with no gross evidence of its origin from a polyp.

bowel is found in close proximity to benign polyps, and the early carcinomatous change occasionally demonstrated in these polyps suggests an etiologic relationship between polyps and cancer that cannot be denied. In our series, 20 per cent of the polyps were associated with a frank carcinoma of the bowel (table 3).

Recently one of our surgeons[7] discovered an unusual polyp in a portion of sigmoid colon which he had resected. The carcinoma had invaded the stalk of the polyp and had extended eccentrically outward from its base to form a roughly circular carcinomatous ulcer. The main body of the polyp which was reddish purple in color showed some embarrassment of its circulation, due to this extensive invasion. These findings suggest a possible evolution from a simple adenomatous polyp to a frank carcinoma which is illustrated by the drawings shown in figure 1.

Swinton[11] has reported that in 827 cases of carcinoma of the large bowel there were associated polyps in 25 per cent, and that in 14 per cent of the patients the malignancy could be shown to have arisen from a pre-existing benign polyp. In the present series, a microscopic analysis of the polyps removed from 181 patients (table 2) demonstrated that in 59 per cent of the patients the polyps were benign and in 41 per cent they were either malignant, or showed what was interpreted as a premalignant change. Our pathologist, Dr. Walter W. Brandes, is convinced that if serial sections were made of all polyps, more than 50 per cent would show some evidence of at least an early malignant change. In contrast to this estimate, Walske[12] reported that in a total of 151 polypoid lesions, he found microscopic evidence of malignancy in 14 per cent.

SYMPTOMS AND DIAGNOSIS

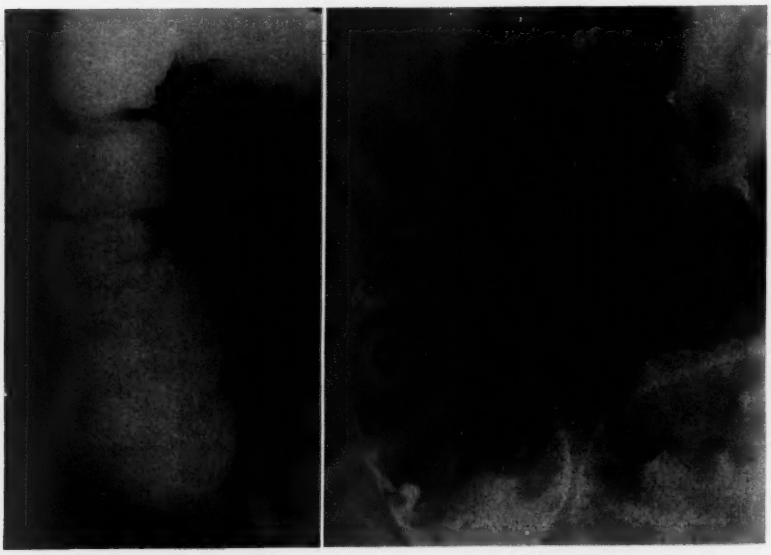
As indicated by the 7 per cent incidence of polyps found at autopsy, many patients must either be without symptoms or else have vague and minor ones that are overlooked. In our experience the most frequent symptom has been recurrent rectal bleeding, the character of which varies with the location of the polyp. In the case of low-lying polyps, only the outer surface of the stool is likely to be coated bright red. When the polyps occur at a higher level, particularly the right colon, the blood is likely to be a dark red and mixed in with the stool. Recurrent rectal bleeding was a symptom in over 50 per cent of our patients. Other symptoms noted were change of bowel habits, constipation, bouts of diarrhea and vague abdominal cramps.

Larger polyps may cause varying degrees of partial obstruction and may occasionally form the head of an intussusception. A pedunculated polyp originating in the sigmoid colon may intussuscept sufficient bowel to make its appearance outside the anal canal. Recently one of our residents missed the golden opportunity to remove such a polyp by simple transfixion of the pedicle. When the patient was presented to him in our Emergency Department, he quite understandably pushed the polyp back inside the sphincter before he had the patient admitted. The next day he was amazed when sigmoidoscopy failed to reveal the lesion within the 25 cm. limits of the scope. A barium enema finally demonstrated the polyp with its base located high in the sigmoid colon.

Some polyps will be demonstrated by careful digital rectal examination; this method combined with sigmoidoscopy, has accounted for the discovery of about 56 per cent of the lesions which have been removed on our Surgical Service. The X-ray Department is responsible for the discovery of a steadily increasing number of these lesions as their technic and interpretation improve.

In the past few years, there has been an increasing awareness that a colon in which one polyp has been found may contain others, and that it is important to locate all of them preoperatively if possible. Experience has proved to us that the air contrast enema can demonstrate lesions that cannot be seen in the routine enema x-ray films, even on retrospective re-examination. We also have learned that lesions exist in a certain percentage of patients, that are not demonstrable even with repeated air contrast studies (fig. 2). One must appreciate how difficult it is to palpate a moderately large polyp through the bowel wall at operation, in order to realize the importance of having the smaller ones well localized by preoperative x-ray study.

The technic of the barium enema examination has greatly increased our diagnostic accuracy. The procedure now in use at the Roosevelt Hospital is as follows: The barium mixture is introduced under fluoroscopic control, and during the course of instillation a spot film is taken of the sigmoid region. When the colon is completely filled, 14 by 17 films are taken in the supine, and left supine oblique



A B

FIG. 2. (A) shows filled colon negative except for area of decreased density in low ascending colon: (B) air contrast shows 2 large polyps in ascending and 1 in transverse colon. (At operation the surgeon discovered 11 polyps, only 4 of which had been demonstrated on the air contrast films. One of the polyps not revealed by the x-ray examination proved to be malignant).

positions, and a lateral of rectum and sigmoid on a 11 by 14 film is also taken. After the patient evacuates, a 14 by 17 film is taken in the prone position.

The wet films then are reviewed by the fluoroscopist, and more are taken if indicated. If the patient has a satisfactory evacuation of the barium, retaining only a thin coating, the examiner proceeds with the air contrast study. After the air is instilled, 14 by 17 films are taken in the supine, prone, and left supine oblique positions. Some examiners take more films than we do; others take only one 14 by 17 of the full colon and one 14 by 17 after evacuation. We believe that our technic is a practical compromise. Since the air study involves added expense for the patient, it is done only if there is a specific request by the referring physician, or if the radiologist thinks it is indicated after he has reviewed the standard films.

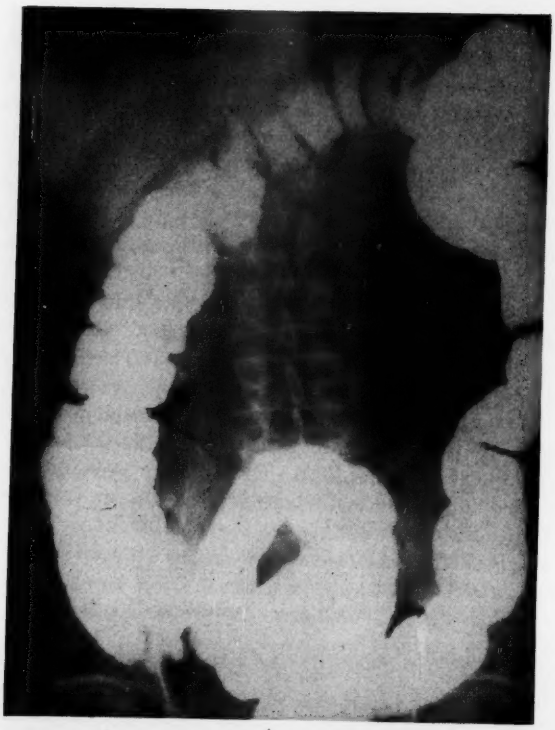
Experience has taught us that the air study will not be of diagnostic value if more than a thin coating of barium is retained in the colon after evacuation. Therefore, if evacuation is considered unsatisfactory because of too much retained barium, the examination is discontinued and the patient is asked to return at a later date to repeat the air study.

The three stages of the barium enema examination are: (1) films of the full colon, (2) postevacuation films, (3) air contrast films. If a lesion is seen or suspected in the films of the full colon or in the postevacuation films, the air contrast study is always made. A positive diagnosis of a polyp is made only after the lesion is seen on at least three films, taken in different projections or different stages of the examination. If a lesion is seen on only one or two films, it is considered questionable and the examination is repeated at a later date.

The appearance presented by a polyp varies in the different stages of the study, as here described. When the colon is filled with barium, it is difficult to differentiate a true polyp from air or feces, because each appears translucent in marked contrast to the barium. Most fictitious polyps are due to air bubbles and are perfectly round. However, in a well prepared patient, the appearance of any radiolucent shadow on the film of a filled colon demands careful inspection of that area on subsequent films and stages of the examination (fig. 2, A).

On the postevacuation films, large polyps, 2.5 cm. or more, will be apparent because they prevent the colon from contracting over them. If the colon is distended, all polyps larger than 1 cm. tend to cause an alteration in the mucosal pattern because of its partial obliteration. Each polyp causes a slight area of increased density which stands out in contrast to the surrounding area. Polyps of less than 1 cm. are only rarely detected on evacuation films. Air bubbles can be differentiated because they are more lucent. Feces have the same density as polyps but are more likely to be mottled and have a less sharp periphery.

The air contrast study is perhaps the most valuable phase of the examination. These films differentiate polyps from most artefacts, and also demonstrate lesions as small as 3 to 4 mm. When the barium coating is thin, all polyps cast a definite shadow of increased density in contrast with the surrounding air-filled bowel. On occasion, the double contrast created by the air will depict the polyp so vividly as to create the illusion of depth (figs. 2, 3).



A

B

FIG. 3. A. Filled colon is negative. B. Air contrast reveals large polyp in sigmoid loop.

TREATMENT

In the treatment of adenomatous polyps, we must appreciate their malignant potentialities and effect their removal in the simplest possible manner. There is little doubt that many, if not all, carcinomas of the colon arise from benign adenomatous polyps, and it is our conviction that they should all be removed once their presence is detected.

When a polyp is located in the rectum, it may be removed by direct approach. Anal dilatation may allow the polyp to be grasped and brought outside the sphincter, or the polyp may be removed through a proctoscope. In some patients, a posterior midline proctotomy incision is made in order to expose the polyp more easily and to safely excise it under direct vision.

If sigmoidoscopy is employed to remove lesions in the rectum, it should be borne in mind that the rectum is about 12 cm. in length and is likely to be intraperitoneal in its upper portion. If the polyp is on a long pedicle that arises above the peritoneal reflection, it may be prolapsed to the outside and safely removed, with or without the aid of a proctotomy incision. The sessile or short-pedicled polyp that lies high in the rectum or low in the sigmoid presents a different problem in treatment. In the course of removing such polyps through a sigmoidoscope, intraperitoneal perforation of the bowel wall presents a hazard that should always be kept in mind, regardless of whether one uses the biopsy forceps or the coagulation current. In addition to the dangers of perforation and peritonitis, there is the possibility of inadequate removal. This has added significance if the final microscopic examination shows that the polyp is a malignant one with invasive characteristics. There is no doubt that polyps situated above the peritoneal reflection can be removed more adequately and safely via the abdominal route, employing a colotomy incision.

A more debatable surgical problem is presented by those polyps that show a malignant change. When these are accessible to the sigmoidoscope and a preliminary biopsy has been accomplished, the surgeon can plan his mode of attack in advance. His choice of procedure will be based on the known invasive and aggressive nature of the lesion, as well as its location. In the majority of instances, a wide local excision of the rectum or sigmoid is sufficient. In some instances, the patient will require an anterior or segmental resection, and only rarely will an abdominoperineal procedure be required.

When the polyp is not accessible to the sigmoidoscope, no preliminary biopsy report is available and the surgeon must rely on a frozen section diagnosis. This method of diagnosis in relationship to colonic polyps can be misleading, as we all know. However, some characteristics exhibited by polyps on gross inspection can be helpful in giving a clue to their nature. On the basis of gross appearance, the following suggestions as to treatment are offered (fig. 4):

1. A smooth-surfaced polyp on a long pedicle can be excised at its base with reasonable safety. Although the microscopic sections, when available, may show peripheral anaplastic changes, the likelihood of invasion of the pedicle with lymph node involvement is minimal.

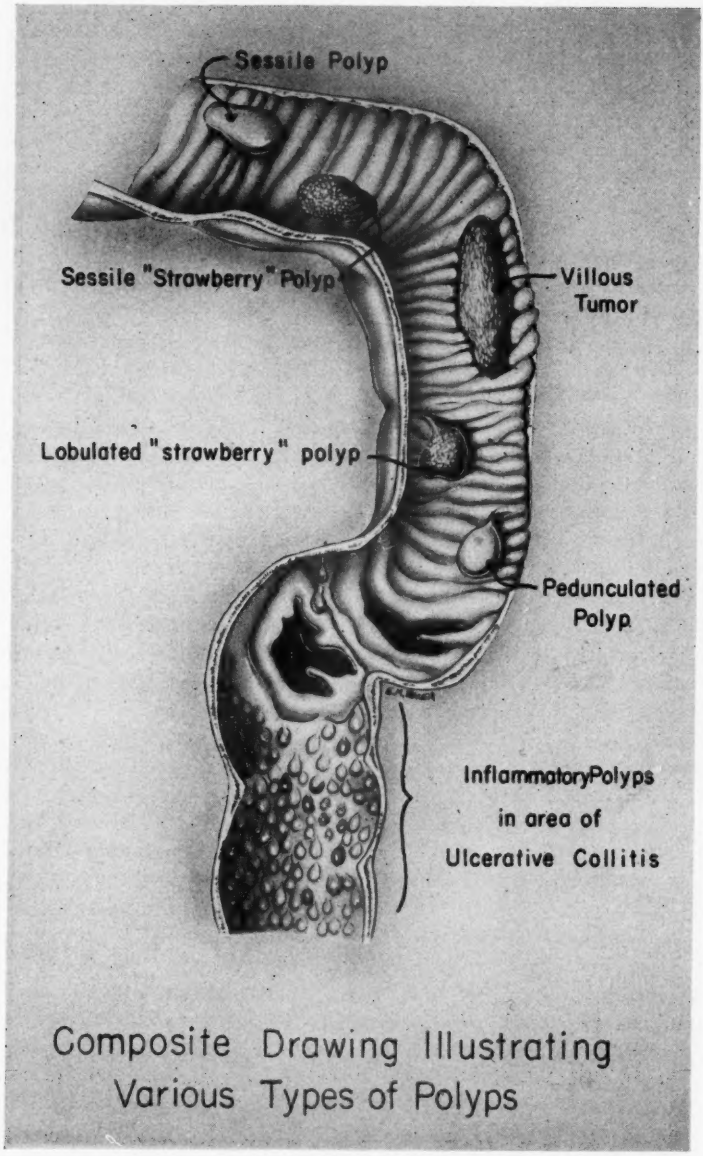


FIG. 4

2. A broad-based or sessile polyp is more likely to have undergone malignant change, as in its original state it may have been a pedunculated polyp. Since it is in more intimate proximity to normal appearing mucosa, it demands wide excision. The nearer this type of lesion is situated to the mesenteric border, the

more urgent is the need to perform a partial colectomy, with removal of adjoining mesentery and node-bearing area. Segmental resection of the bowel is recommended for all sessile polyps except, perhaps, those located on the extreme antimesenteric part of gut where a very wide excision can be safely accomplished.

3. "Rough-surfaced" or "strawberry-like" polyps (fig. 1), whether on a pedicle or a broad base, are more likely to have undergone malignant changes, and should therefore be treated more aggressively. The "villous" polyp should be placed in the same category.

Colonoscopy performed at the time of abdominal exploration is a valuable adjunct to treatment. As we have gained experience in the use of the sterile sigmoidoscope, introduced through one or more colotomy incisions, we have been more and more impressed at the number of polyps that we would have otherwise failed to detect or locate. Thorough mobilization of the splenic and hepatic flexures allows examination of longer stretches of bowel, and thus decreases the required number of colotomy incisions. In some patients, one colotomy incision in midtransverse colon will thus allow inspection of the entire colon from cecum to sigmoid.

It is not in the scope of this paper to discuss the results of treatment. The final follow-up of these 181 patients would take many years to be of any significance.

SUMMARY

A report is made of 313 adenomatous polyps of the large bowel removed from 181 patients in a 5 year period. Polyps were malignant or showed some evidence of anaplasia in 41 per cent of the patients. Multiple polyps were found in 25 per cent of the patients.

Polyps were found to be associated with a frank carcinoma in 20 per cent. An unusual polyp is described that vividly demonstrates a transitional stage from polyp to a frank carcinoma.

The x-ray technic employed at the Roosevelt Hospital is described, placing emphasis on the importance of air contrast films.

Treatment is discussed in relationship to both the location and the pathological characteristics of adenomatous polyps of the large bowel.

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THE CONTROVERSIAL BRANCHIOGENIC MALIGNANCY

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Scattered throughout the surgical literature is the controversial subject of malignant branchiomas. Credit has been given Volkmann[21] for having initiated these discussions. In 1882 he suggested that the origins of some neck malignancies were associated with persistent branchial remnants. Following his publication, numerous articles appeared relative to primary malignant tumors associated with branchial fistulas and cysts. In reviewing these we found some whose diagnostic criteria were questionable, some did not follow up their cases for substantiating proof, and others devoted a minimum of attention to possible primary sites in the mouth, pharynx, esophagus, bronchi, sinuses, thyroid and salivary glands. However, many of these were published before our present day knowledge of pathology and should not receive unjust criticism. Although fewer in number, papers have been published which regard the branchiogenic carcinoma as a nonexistent clinical entity.

From a surgical standpoint it is extremely advantageous to know the primary origin of a malignant tumor located in the neck. Once the origin has been established the lesion and its spread may be approached encouragingly. On the other hand, a known malignancy of the neck with an unknown primary site may lead to poor surgical judgment with a disappointing prognosis.

Those[4, 5, 7, 8, 20] who do assume that branchiogenic malignancy is a reasonable diagnosis are under the impression that such tumors originate from vestigia due to defective embryonic obliteration of the branchial cleft apparatus. This theoretic origin is vaguely understood but its academic interest merits discussion. In the first few weeks of embryonic life there appears in the cervical region a group of arches, pouches and grooves. Some anatomists describe 6 pair of arches (branchial or visceral) externally and 5 internally (fig. 1). There are others[9] who do not agree in regard to the number of arches. The internal arches are separated by pouches lined with entoderm, whereas the external arches are connected by grooves lined with ectoderm. There is a mesodermal layer between the internal pouches and the external grooves, but this is scanty in areas and even may be absent in some regions. Where the mesoderm does not exist, the entodermal and ectodermal layers fuse. In the fish this fusion does not take place and gills form, thus producing a communication between the pharynx and the outside. In the mammal, clefts do not persist normally and the branchial structures develop to form important anatomic parts of the head and neck. As the branchial arches fuse, the branchial grooves disappear with the exception of the first which forms the acoustic apparatus.

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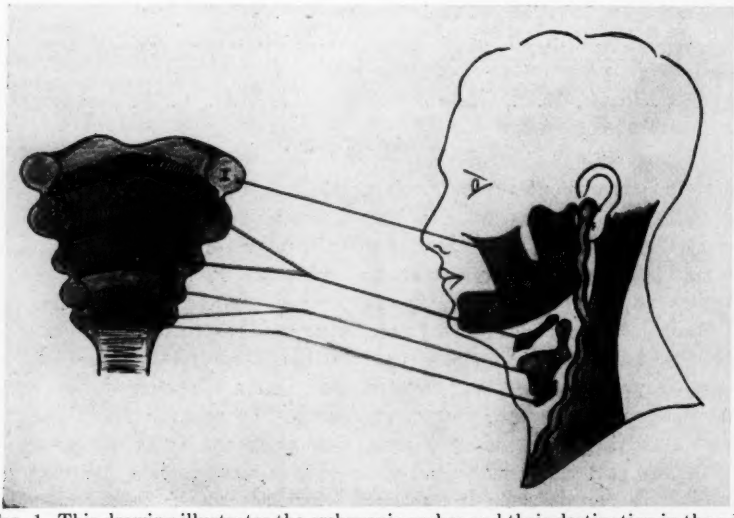

FIG. 1. This drawing illustrates the embryonic arches and their destination in the adult. The heavy lined tortuous canal extending from the auricle to the jugular notch is an imaginary line where branchial cleft anomalies usually appear. The *first* arch forms the adult mandible, masticatory muscles and related structures. The *second* arch makes up the hyoid bone, styloid process, stylo-hyoid ligament and unites with the *third* arch. The *fourth* and *fifth* arches join to construct the thyroid cartilage. The *sixth* arch forms the cricoid and arytenoid cartilages. The branchial pouches and grooves also are destined to furnish the adult with important anatomic structures.

Theories are numerous concerning the development of branchial cleft fistulas, cysts and tumors[2, 9, 10, 11, 16]. A few of the more discussed hypotheses may be summarized as follows: The branchial cleft theory suggests that there are 5 branchial arches separated by clefts and if any of these clefts do not become obliterated by archal fusion a fistula results. Rabl's theory[18] stated that usually a cessation of growth of the second arch with a break in the mesoderm can form a fistula (the precervical sinus), whereas Bland-Sutton[3] was under the impression that any of the branchial cleft structures could be responsible for a fistula or tumor. Wenglowski[22] thought that branchial anomalies could only occur above the hyoid bone and that the thymopharyngeal duct, which is an invagination of the central part of the third branchial groove, was the anlage for cysts and fistulas below the hyoid. Frazer[6] suggested that "placodal cysts or ducts" were the cause of these anomalies. Lorenz[12] related the tumor to embryonic rests in the immediate locality. Regardless of the theory which one believes, it is the concensus that any persistent vestigium of the branchial cleft apparatus may produce a fistula or cyst which in turn may undergo metaplasia and resultant malignant changes. McKenty[14], McWhorter[15] and others believed it is not unreasonable to assume that a neck cancer may arise from an epithelial rest. Albertini[1] stated "Carcinomas are differentiated microscopically as compact and cystic forms. They are differentiated microscopically as to the histogenetic pattern between squamous cell and nondifferentiated carcinoma. The latter are desig-

FIG. 2. This is a photograph of the gross specimen in cross section exhibiting the tumor within and invading the branchiogenic cyst wall.

nated erroneously as basilioma". According to the same theory this latter type arises from columnar epithelium. Oliver's[17] opinion expressed in his excellent review of this subject is impressive. He believed that the site of embryologic origin may become obscured by carcinomatous invasion. This was not true in our case which showed carcinoma within and invading a branchiogenic cyst wall (fig. 2).

Clinically, masses found in the neck may be as difficult to diagnose as any surgical lesion. A preoperative diagnosis of malignant branchioma is merely a speculation, and there are those who think that it cannot be diagnosed even postoperatively. A few of the various lesions seen in this region which must be differentiated from branchial cleft carcinoma are carotid body tumor, lymphosarcoma, tuberculous adenitis, aberrant thyroid follicles, epidermoid cyst, dermoid cyst, lymphohemangioma, aneurism, parotid tumor, lipoma, thyroglossal duct cyst, Mickulicz disease and chronic retropharyngeal abscess. Although age, sex, duration and site have been used as criteria for diagnoses, these may lead to erroneous conclusions. Branchial cleft disease has been seen in the child[18] as well as the

geriatric patient. Although most of these tumors are found in the male, they also occur in the female. They may be found anywhere between the zygomatic area and the clavicular region, but most of them appear anterior to the sternocleidomastoid muscle near the carotid artery bifurcation. The mass may present itself in various ways. It may be deep or superficial, not attached to the integument or fenestrated through it, firm or soft, and painless or tender.

Whether a punch, needle or scalpel section of tissue is removed for biopsy purposes makes little difference. We believe that many of these sections do not represent the lesion because there may be malignant change in an area not removed by such methods. It is important to present the pathologist with a generous supply of tissue and only then can we depend upon his diagnosis. A positive diagnosis of malignant branchioma cannot be made by minute sections of tissue removed by a punch or a needle. This very important point is demonstrated clearly in figures 3 and 4.

Grossly, the pathologic picture may be that seen in any malignant tumor of the neck. On cut section it may be smooth and firm, lobular, cystic, necrotic, fibrous, granular, hemorrhagic, friable, or degenerated. The microscopic features usually are just as confusing and many experienced pathologists doubt a positive diagnosis of branchiogenic cancer. Some agree that if a carcinoma can be demonstrated growing in an epithelial-lined branchial cyst, they would not hesitate to make a diagnosis of carcinoma. Figure 2 which is a photograph of the gross specimen of our case demonstrates this finding.

FIG. 3. This is a lower power photomicrograph of one portion of the branchial cyst. There is a normal appearing stratified squamous epithelial lining with multiple islands of squamous cells, which appear to be imbedded but only are so because of the convoluted surface of the cyst wall. A needle or punch biopsy from this normal benign section could be misleading and diagnosed as a malignancy.

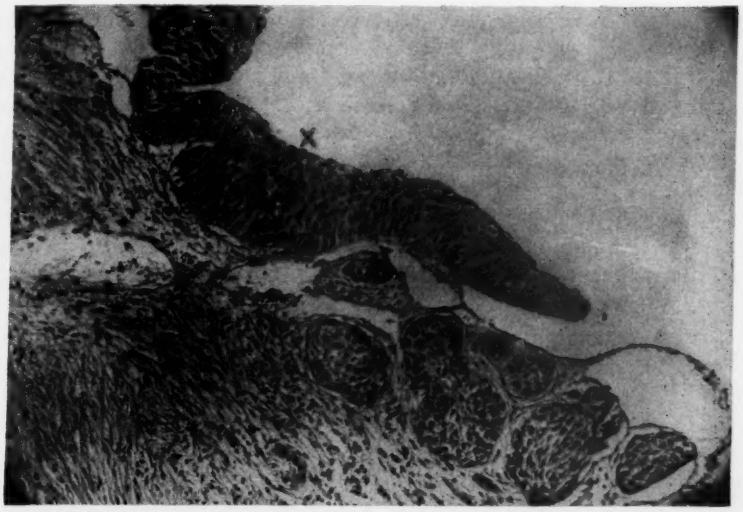

FIG. 4. This is a higher power photomicrograph of the marked area of figure 3. These "islands" of squamous cells are invaginations of the cyst wall cut on a tangent with the microtome and erroneously producing a "probable diagnosis of cancer". A needle biopsy into this region certainly would be confusing, especially in the presence of the cellular atypical hyperplasia marked X.

Martin and associates[13] in a superb article insisted that, in order to make a diagnosis of malignant branchioma, all patients survive 5 years following the diagnosis without development of another lesion which could be the primary. This criterion is difficult to understand. It is known generally that more than one malignancy may be present in any given patient. It also is well authenticated that the patient already may have had the lesion for a number of months or years before a diagnosis is determined and that a 5 year survival would not be a true estimation. It has been proved that the so-called malignant branchioma is a highly malignant lesion and the prognosis is exceedingly discouraging. One author's review of 80 cases showed a mortality rate of 97 per cent.[17] Also, one must realize that many of these patients do not return for follow-up examinations and even a lesser number come to autopsy. With these points in mind, one questions the validity of the diagnostic criterion of Martin and co-authors.

TREATMENT

Cervical neoplasms, regardless of their nature, can only be treated with success by first making a correct diagnosis, planning their management and then following them closely posttherapeutically. The choice of the method of therapy is no better than the way it is utilized. Failures of treatment many times are due to a delay in diagnosis but with the growth of tumor clinics, group conferences and teaching institutions, failures are decreasing. In outlining the management, we have found it best to tell the patient, his kin or guardian the dangers of malignancy and what to expect. Most families are aware of this and desire to know

any complications which may ensue. Regardless of the therapeutic approach, it is important to completely extirpate the primary lesion and its channels of spread. In many instances it is necessary to destroy or remove wide areas with resultant visible deformities. These deformities usually are remedied by reconstructive surgery with an acceptable cosmetic result. We prepare our patients with cervical tumors for radical surgery and, if the diagnosis of malignancy is established, we never remove the tumor by a local excision but always treat them by radical neck dissection. We advocate follow-up irradiation therapy in malignancies of branchiogenic origin. The reason for this plan of therapy is that the prognosis is very disappointing and the patient should be given every possible chance for recovery.

CASE REPORT

A tool and dye worker who was 49 years of age first became aware of a lump in his left neck approximately 6 months prior to his first examination by a local physician. He was referred to us for evaluation and a preoperative diagnosis of branchial cleft cyst was entertained. The mass presented itself immediately anterior to the sternocleidomastoid muscle at the level of the carotid artery bifurcation. At operation it was found firmly adherent to the carotid sheath and was followed internally to the tonsillar fossa region. The surrounding tissue was much indurated and friable. A section was given to the pathologist, Philipp Rezek, who reported the tissue as squamous cell carcinoma (figs. 5, 6). This was followed by a left radical neck dissection including the overlying integument, the sternocleidomastoid muscle, the carotid sheath, the internal jugular vein, the lymphatics of the neck, including the submaxillary triangle contents, and the tail of the parotid gland. Examination of the oral cavity, nasopharynx, larynx, thyroid gland, salivary glands and contralateral neck lymphatic nodes showed no palpable or visible pathology. Roentgenograms of the si-

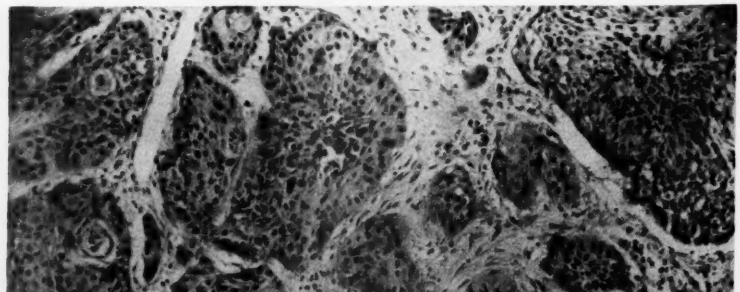

FIG. 5. This photomicrograph shows the infiltrating moderately well differentiated squamous cell carcinoma. The anisonucleosis, cellular pleomorphism and tendency to pearl formation are demonstrated. This section was taken from the specimen shown in figure. 2

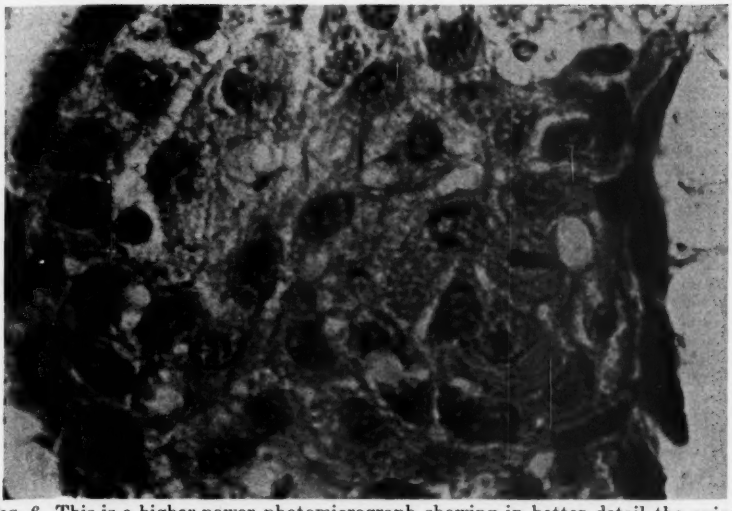

FIG. 6. This is a higher power photomicrograph showing in better detail the anisonucleosis with coarse chromatin dispersion and mitotic activity.

nuses and chest were negative. The patient was in the hospital for 3 days postoperatively and then was followed at weekly intervals. Three months later a small smooth mass was palpated inferior to the left ear. It was thought best to hospitalize the patient again and at operation the mass was found to be malignant. It was squamous cell carcinoma which was the same type of tissue as the primary lesion. A wide resection of this area, including most of the parotid gland, was done. The radiologist, Virgil Pieck, was consulted to administer irradiation therapy and this has resulted in apparent control of the tumor. Search for further primary sites were made weekly for 2 months, then monthly for 12 months. It is now 24 months since the lesion first was recognized. The patient has gained back his preoperative weight, is free of pain, working, and has an excellent mental outlook on life.

SUMMARY AND CONCLUSIONS

We are cognizant of the debatable subject presented and wish to emphasize that the term, malignant branchioma, should not be used freely for all malignant growths found associated with branchial cleft cysts and fistulas of the neck. Numerous articles reviewed were not included because they presented nondependable evidence. We are under the impression that such a branchial cleft carcinoma may exist and that when it is seen, early and radical therapy should be instituted. Our case is presented as a primary carcinoma of a branchial cleft cyst.

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SARCOMAS OF THE SOFT SOMATIC TISSUES*

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Introduction: Sarcomas of the soft somatic tissues comprise 0.7 per cent of all admissions to the Memorial Hospital Clinic, 0.8 per cent of all malignant tumors, and 6.58 per cent of malignant tumors occurring in patients under 25 years of age. The present report is based upon a personal experience with 717 malignant tumors of the soft somatic tissues being treated in a single department, the Mixed Tumor Service of the Memorial Cancer Center. During this time, the natural history of the different types of sarcomas of the soft somatic tissues has been studied and the plan of therapy undergone constant evolution by trial and error, so that it constitutes, perhaps, the largest single group of cases which have been followed in one service over a period of a quarter of a century.

Biopsy of Soft Part Somatic Sarcomas: If the sarcoma is ulcerating or fungating, then and only then do we take a formal or orthodox biopsy, using an endotherm loop with bipolar coagulating current. If the tumor is small and of uncertain type, we prefer to excise the neoplasm in its entirety rather than to remove a portion of it for histologic identification. A total specimen is then available for immediate frozen section analysis without the hazard of surgical trauma. If sarcoma is found, the surgeon may elect, depending on the circumstances, to perform a more thorough dissection with removal of the environmental tissues.

Aspiration biopsies of deeply situated intermuscular tumors have been successful in our hands. We have not encountered any handicaps or serious complications from this diagnostic operation, which we have done under local anesthesia using a 17 gauge aspirating needle. There has been no instance of fungation of the tumor through the needle tract. The critics of aspiration biopsy have been too specific in their demands of the method. All we ask of our pathologist is to distinguish between inflammatory and neoplastic tissues, and if the tumor is a true neoplasm to give us an opinion as to whether it is benign or malignant. We do not expect the pathologist to make a commitment concerning the histogenesis of the tumor on the basis of the small specimen received in the plug of the aspirating needle. If the pathologist is content to say that the tumor is a malignant type, then the surgeon depends on the local setting of the tumor, its size, its invasive characteristics, its location and other features to make a decision as to what method of therapy is indicated—such as radical surgical dissection, amputation or preoperative irradiation. A negative aspiration biopsy is discounted and no significance is attached to it, particularly if the tumor is of a fibroplastic character. In our experience, 15 per cent of the aspiration biopsies do not give satisfactory material for the pathologist to be of aid in a diagnostic way.

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When an accurate biopsy report is imperative because the decision dependent on such a report will influence the choice of therapeutic procedures, such as radical local dissection or amputation, then a formal incisional biopsy may be necessary. The hazards of such a procedure should not be minimized. Occasionally these sarcomas are so highly vascular that an incision into the tumor may result in almost uncontrollable hemorrhage. Again, the tumor may be growing under great pressure with central liquefaction so that incision through the tense pseudocapsule may result in a sudden extravasation of liquefied tumor throughout the wound with inevitable contamination, even though the wound be protected as much as possible. Incision through such a capsule, if not followed by immediate extirpation, may result in fungation of the sarcoma through the wound as well as tremendous growth activation rendering the neoplasm no longer locally resectable, and forcing amputation as the necessary treatment if the neoplasm be located on an extremity.

The technic of performing an incisional biopsy on a suspected sarcoma of the extremity is always to employ a proximal tourniquet above the tumor. When the specimen is submitted for frozen section analysis the tourniquet is left in place until the report is obtained. If the local anatomic relationship of the sarcomas is such that a report of malignant tumor would necessitate an amputation, such amputation is done above the level of the tourniquet applied prior to the incisional biopsy.

Regional Distribution of Sarcomas of the Soft Somatic Tissues: The localization of the histogenetic varieties of soft part sarcomas is not absolutely specific and is not statistically dependent on the proportion of any tissue in the given region. However, by making scattergrams of the location of the sarcomas of the different histogenetic types, one can see the evolution of patterns of their distribution which is somewhat helpful in a relative diagnostic sense. It is evident that certain predilections seem to exist for the occurrence of soft part sarcomas in certain regions. Kaposi's idiopathic hemorrhagic sarcoma usually develops in multicentric foci on the feet, occasionally on the hands, rarely on the penis or in the oral mucosa. Liposarcomas show a predilection for the shoulder and pelvic girdle in common with the benign lipomas. Synovial sarcomas occur preponderantly on the feet and in the neighborhood of the knees. Rhabdomyosarcomas are discovered in greatest frequency in the upper portions of the thigh and arm. The pure fibrosarcomas not admixed with other types are quite generalized in their distribution with perhaps some regional frequency in the shoulder and thigh, whereas the dermatofibrosarcoma protuberans occurs in the majority of instances on the trunk. The malignant neurilemoma is encountered frequently in the neck and in the distal part of the extremities, such as the forearm and leg.

Do Benign Somatic Tumors Ever Become Malignant? The majority of sarcomas of the soft somatic tissues apparently are malignant in their very incipiency. The benign tumors of the same histogenesis seldom undergo malignant degeneration, but there are some exceptions to this rule. More important than the academic question of whether a given benign soft part tumor *can* and *does* become malignant is the differential diagnosis as to whether or not a given tumor *is* benign or

malignant. The greatest confusion exists in the diagnosis and management of diffusely growing fibromas involving fascia and subcutaneous tissue. Under microscopic scrutiny many of these tumors are classified as benign, but their behavior is characterized by successive recurrences and ultimate wide extension of the disease and final fatal outcome, particularly when successive recurrences are increasingly cellular, which would indicate that the tumor probably is a low grade fibrosarcoma or becomes so in the course of its evolution. An example of this is the occasional tendency of the desmoma of the abdominal wall to become increasingly anaplastic and ultimately to metastasize, particularly when aggravated by the hormonal influences of subsequent pregnancies. In patients with von Recklinghausen's neurofibromatosis, malignant neurilemomas have developed, in our experience, in approximately 10 per cent of such patients. Some of these sarcomas of nerve sheath origin are multicentric. The angiomas are seldom involved in malignant degeneration but there have been several instances in our experience, particularly of lymphangiomas, which have ultimately become converted to malignant angio-endotheliomas when previous x-ray therapy has been given to obliterate the benign tumor. Some of the large lipomas have undergone xanthomatous or myxomatous degeneration with liposarcoma developing years after the known presence of the lipoma. Synovial sarcomas seldom originate from benign pre-existing tumors of tendon sheath, but there have been a few instances in which this transformation has been evident.

Do Sarcomas of the Soft Somatic Tissues Metastasize to Regional Lymph Nodes? The influences determining the routes of metastasis of malignant tumors include the histogenesis of the tumor, its invasive tendency, its vascularity, the distribution and character of its blood and lymph supply and the specific site or organ involved by the malignant neoplasm. The greater number of sarcomas of the soft tissues metastasize through the blood, and it is not generally appreciated that a certain number of them will spread through the lymphatics into regional lymph nodes. The malignant synoviomas, the rhabdomyosarcomas, the angiosarcomas and the spindle cell sarcomas of undetermined histogenesis are the varieties of soft part sarcomas which are prone to have lymphatic dissemination to regional lymph nodes as well as dissemination by the blood vascular system in some instances. This information is valuable to the surgeon as it modifies the scope of his plan for regional dissection of the primary sarcoma to include the regional lymph nodes if the tumor is closely situated to the lymphatic drainage basin.

Principles of Surgical Treatment of Sarcomas of Soft Somatic Tissues: In a particular case of sarcoma of the soft tissues, the surgeon in his decision whether to perform a radical surgical dissection or amputation must take into consideration the histogenesis of the tumor, its degree of malignancy, the fixity or mobility, the original location, the primary or recurrent status, the presence of regional and distant metastases, and finally his experience and judgment.

The surgeon should be thoroughly familiar with the behavior patterns of the sarcomas of different histogenetic types in order to plan his treatment accordingly. It is proper to secure preliminary consent for amputation prior to any

operation on soft part sarcomas of the extremities because at the time of the attempted radical local dissection it may be found that the extent of the tumor and its invasiveness may preclude the possibility of cure by local operation.

The sarcomas usually are not encapsulated, but the covering of the tumor is a pseudocapsule composed of condensation of fibrous components of the neoplasm itself. The apparent encapsulation offers a great temptation for simple enucleation because of the ease with which the tumor is dislodged from its bed. Such a temptation should be resisted, however, and the operation planned should be of a radical character with removal of all of the tissues surrounding the sarcoma. Retraction by the assistant should always be away from the tumor so that the neoplasm proper is not compressed. If a radical dissection is done for a sarcoma involving the extremities, a tourniquet is applied superior to the upper limits of the tumor, the tourniquet remaining in place during the execution of the biopsy and while the surgical dissection is being done. If the radical local removal of the sarcoma fails, or it becomes increasingly evident as the operation proceeds that the local operation will be futile, the amputation is immediately performed *above* the tourniquet which had been previously applied.

If an exploratory exposure of the sarcoma has been done without removal of the neoplasm; if a diagnosis has been previously established by a formal incisional biopsy; if a recurrence develops after incomplete excision of the tumor; or if the sarcoma fungates through the wound and yet a successful radical dissection of the tumor is considered feasible by the surgeon, it is an urgent necessity that the entire scar of the previous incision be completely removed with the specimen. The sarcoma is removed without the tumor being visible or encountered in the course of the dissection, that is to say, the line of the dissection must extend well beyond the discernible boundaries of the neoplasm and to remove the neoplasm with the enveloping muscles, fat and fascia. The muscles which are involved which surround the sarcoma should be removed from their origin to their insertion. For sarcomas of the arms and legs radical surgical dissection is done with the order of dissection from above downwards.

Radiation therapy as an aid in the management of sarcomas of the soft somatic tissues must be given a proper place in the armamentarium of the therapist. In our experience there have been many instances in which technically inoperable sarcomas have received preliminary irradiation which has permitted resection and ultimate cure. With the combination of radiation treatment and surgical excision it has been possible to perform radical surgical dissections of certain sarcomas and to avoid amputation of a limb. It entails some knowledge of the radiosensitivity of the sarcomas of varying histogenesis and some familiarity with the physical principles of irradiation in order to employ these methods of therapy conjointly.

Principles of Amputation for Sarcoma or Soft Part Sarcomas of the Extremities: Only the experience of the surgeon can dictate his decision as regards each specific instance of sarcoma involving the upper or lower extremity. Such factors as the location of the tumor, its histogenesis, the degree of malignancy, its primary or recurrent status, its encapsulation or its infiltrative method of growth may modify

the ultimate choice of procedure. The decision concerning the superior limits of severance is an important one as it may mean the difference between cure and local recurrence. The law which we have constantly observed has been to amputate superior to the level of origin of the muscle groups involved by the sarcoma. Some of the principles which have been adopted over the years in the management of soft part sarcomas of the extremity by amputation may be adumbrated as follows:

1. Rhabdomyosarcomas sometimes are of multicentric origin, so much so that it is imperative that all the muscle groups in which the tumor occurs should be removed in their entirety else late recurrence may develop from the cryptic foci which are impalpable at the time of the resection.

2. Sarcomas of the soft somatic tissues tend to infiltrate along the fascial and muscular planes far superior to the palpable limits of the tumor.

3. Fascial fibrosarcomas often are so diffuse in their manner of growth and so prone to recur locally that the entire fascial sheath should be removed even if this necessitates the removal of the periosteal base of attachment superior to bone.

4. In the amputation of an extremity for malignant neurilemomas the surgeon must exercise cautious judgment concerning the safe level of amputation because of the tendency of these tumors to extend centripetally upward along the nerve sheaths and the coexistent beading of the nerve trunks by the neurofibromatous process characteristic of von Recklinghausen's disease.

5. The invasion of bone by these soft part sarcomas permits subperiosteal and intramedullary extension of the tumor along the shaft in consequence of which amputation either through or above the joint with which the diseased bone articulates is performed. It is our opinion that there is no place in the roster of cancer operations for disarticulation of the humerus; in place of humeral disarticulation we favor interscapulo-thoracic amputation contending that it is more radical, ultimately safer and crippling in no greater degree. In the lower extremity, however, conservation of the upper portion of the thigh is of greater functional importance because the preservation of even a small stump is an advantage in adaptation to an artificial limb. In a series of 228 consecutive major exarticulations including interscapulo-thoracic amputations, hip joint disarticulations and interilioabdominal amputations performed on the Mixed Tumor Service of the Memorial Cancer Center there have been no operative deaths.

Pulmonary lobectomy and segmental excision for metastatic sarcoma to the lung: The majority of patients who die as a result of sarcomas of the soft somatic tissues do so because of pulmonary metastases rather than of locally recurrent sarcomas or continued growth of the original neoplasm. A common history in the growth of these tumors is that the local radical surgical treatment or amputation often is successful but visceral metastases, usually to the lung, become apparent in succeeding years. Some patients even at postmortem examination reveal no evidence of local recurrence. The type of pulmonary metastases usually is fairly well demarcated as spherical bodies rather than diffuse infiltration of the lung parenchyma.

If the metastasis in the lung appears to be a single focus or if 2 or 3 metastases are confined within the lobule, the surgeon may properly attempt a lobectomy or a segmental resection. Before performing such a thoracotomy with this intent, it is wise to have anteroposterior and lateral tomographic studies made in order to reveal cryptic metastatic foci which might not be seen with the orthodox chest roentgenograms. This discovery of numerous other metastases would avoid an unnecessary major operative procedure. In our series of patients, lobectomy and segmental excision have proved to be of definite palliative benefit when the procedure is employed for such specific indications.

Fibrosarcoma: Fibrosarcoma in this presentation represents a malignant neoplasm which arises from fibroblasts. The identification and study of true fibrosarcomas has been difficult because the literature contains numerous examples in which the type of tissue from which the tumor arose could not be determined; many of these neoplasms were indiscriminately classified as fibrosarcomas because of the large moiety of the malignant connective tissue component which was associated with the neoplasm. Many reported lesions listed as fibrosarcomas have been benign tumors such as fibromas with the outcome exceptionally good or contrariwise malignant neoplasms of other types such as synovial sarcomas have been erroneously reported as fibrosarcomas. These histogenetic errors were made because the prototype cells of the fibroblasts (mesenchyme) have multipotential capacities for development and certain neoplasms may present two or more routes of differentiation. Fibrosarcomas may be mistaken for myxosarcomas as the result of stasis of circulation with resultant edema. Fibrosarcomas usually develop spontaneously with no apparent relationship to any etiologic agent. In some instances fibrosarcomas may develop upon damaged tissues but certain very important criteria must be rigidly fulfilled before such an etiologic relationship can be claimed for trauma. We have observed fibrosarcomas develop in scar or granulation tissues. We have had several instances in which a fibrosarcoma has developed in tissues which had been heavily irradiated; in such instances the fibrosarcoma developed upon irradiation fibromatosis.

It has been claimed that fibrosarcoma may develop from simple fibromas. In some instances it is impossible clinically to distinguish fibromas from slowly growing fibrosarcomas. The low grade malignancy and insidiousness of growth before they produce symptoms of sufficient degree to cause the patient to seek medical attention may be responsible for a long period of delay before treatment. Unencapsulated fibromas of fascia, especially of the extremities, may be classified on excision as histologically benign but are prone to recur, to infiltrate, to extend centripetally toward the trunk, and to show increasing cellularity with successive recurrences until eventually the diagnosis of fibrosarcoma is made. Fibrosarcoma is essentially a disease of younger adults, the average age being 39.4 years.

Fibrosarcomas occur most frequently on extremities but they may occur anywhere within the body where fibrous tissue is present. In our series the upper extremity was most frequently involved, being the site of fibrosarcomas in 56.4 per cent. The lower extremity was invaded in 25.6 per cent and the torso in only

7 instances. The most frequent symptom is the presence of a painless mass which starts insidiously, grows slowly and either reaches huge proportions or more rarely causes the patient to seek treatment because of pressure against a nerve which produces pain or other disability. The growth characteristics of fibrosarcomas follow one of three patterns: (1) they may grow slowly from their inception until they reach a relatively large size; (2) they appear to remain stationary for many years before rapid growth occurs; (3) they may grow very rapidly and metastasize early.

From a well-differentiated, rather benign form of fibrosarcoma every degree of increased malignancy may be noted. Although fibrosarcomas usually exhibit a rather uniform degree of malignancy throughout the entire tumor, a very malignant nidus may be seen in an otherwise well-differentiated tumor. As fibrosarcomas become more anaplastic, less and less stroma becomes evident with increased crowding of the cells, which tend to become smaller and hyperchromatic. Metastases from fibrosarcomas occur rather infrequently, although some metastasize very early. The usual route of dissemination is in the blood stream and the most frequent site of metastasis is the lung, which was observed in 21 per cent of patients in this series. Metastasis to lymph nodes occurs in 5 to 8 per cent of cases.

The method of treatment is radical surgical excision, employing the principles previously stated for sarcomas of soft tissues of all types. Some fibrosarcomas, although radioresistant, are still susceptible to treatment by radiation therapy through the medium of inducing abortive fibrosis and inactivation of growth, although a palpable tumor usually persists. The fact that this end result is possible of accomplishment is not necessarily the proper indication for the substitution of radiation therapy for surgical excision.

The 5 year definitive cure rate for fibrosarcomas is 55.6 per cent, but of the remainder which were not cured at the initial attempt the residual tumor is of a recurrent nature at the site of excision and lends itself to subsequent effort so that the therapeutic 5 year survival rate has totalled, in our experience, as high as 81.3 per cent.

Dermatofibrosarcoma Protuberans: Darier and Ferrand in 1924 described an unusual progressive and recurring tumor of the skin of fibromatous or fibrosarcomatous character. One year later Hoffman reported several similar cases and coined the term "Dermatofibrosarcoma Protuberans". The tumor is rare and is not commonly recognized as a neoplastic entity. The patient usually is a middle-aged individual who has had a painless, slowly progressive subcutaneous growth occurring for several years. It tends to become mammillated and of cobblestone appearance and may reach formidable dimensions without penetration of the fascia or fixation. The bosslike projections may occur as hemispherical sessile tumors or more rarely have the appearance of a pedunculated mushroom-like growth. The overlying skin which always is fixed to the tumor assumes a bluish red or purplish discoloration and as the tumor enlarges becomes thin and atrophic. Once ulcerated, the growth may fungate through a mass of reddish brown granulomatous-like tissue. Under the microscope the tumor is seen to be essentially

a fibromatous or low-grade fibrosarcomatous growth. The overlying epidermis has lost the accessory structures such as hair glands, sweat glands, and oil glands. The fibrous tissue is somewhat vascular and the tumor cells rest directly on the endothelium of the vascular channels, an histologic phenomenon seen only in one other tumor, the sclerosing angioma.

The tumor occurs with greatest predilection on the trunk rather than the extremities. It may occur on the head, scalp, extremities and genitals as well. The rate of growth is imperceptibly slow at first, many years oftentimes elapsing before the tumor starts to enlarge with increasing rapidity. The fibromatous lesion is essentially within the corium, and only in the late stage of its growth does it invade through the fascia to involve the underlying muscle or become adherent to bone. The tumor does not affect the general health of the patient, which possibly accounts for the common delay in the institution of treatment. An analysis of our cases shows that a correct clinical diagnosis of dermatofibrosarcoma protuberans was made in only 41 per cent of patients.

The treatment of this tumor is solely by radical surgical excision. It is not radiosensitive. The high rate of recurrence is due to two factors; namely, failure to appreciate the infiltrative properties of the neoplasm, and consequent incomplete removal. Unless the surgeon succeeds in extirpating beyond the fine projecting rami of the tumor and through completely normal tissue, failure follows and recurrence develops. Most of the larger tumors need to be excised so widely as to require skin grafting to close the defect. Subjacent muscles are excised if the dermatofibrosarcoma infiltrates through the fascia. Simple removal of the lesion with circumferential skin and subcutaneous tissue might prove to be sufficient in many cases, but because of our experience with recurrences we now routinely carry the dissection so deeply that the fascia overlying the muscles is removed with the specimen.

The end results of treatment are very good, with 69.2 per cent 5 year survival without recurrence following definitive surgical excision.

Mesenchymoma: The mesenchymoma has been defined by Arthur Purdy Stout as "A neoplasm composed of an admixture of two or more non-epithelial mesenchymal derivatives that ordinarily are not found together in a single tumor". The primitive mesenchymal cell is endowed with amazing growth energies and is the ultimate ancestor of the various tumors of the soft somatic tissues both benign and malignant. The mesenchymal tumors are composed of two or more somatic tissues of different histogenesis in addition to the variable proportions of fibrous stroma present. The neoplasm may contain adipose, angiomatous, osseous, cartilaginous, hematopoietic, myxomatous and smooth muscle tissues, but such multiple admixtures seldom are found. Each of the component tissues may be as fully malignant as any sarcoma of pure histogenetic type. The potpourri of tissues varies widely in composition and in degree of malignancy. There is no set pattern of composition. The tumors are to be considered largely as dysontogenetic neoplasms originating as developmental aberrations. The proper treatment is radical surgical excision with ruthless sacrifice of the containing tissues, viscus or extremity. Radiation therapy may secure a palliative result of variable duration but cure by such treatment would not be anticipated.

Synovial Sarcoma (*Malignant Synovioma*): Synovial sarcomas constitute 8.4 per cent of all malignant neoplasms of the soft somatic tissues studied on the Mixed Tumor Service of the Memorial Cancer Center. The synovial sarcoma represents those malignant neoplasms which arise from synovial tissue—of joints, tendon sheaths and bursa—and which present histologic features characteristic of synovial tissue. There are innumerable synonyms for this tumor, but those we consider to be most appropriate are synovial sarcoma or malignant synovioma. There are no specific etiologic factors for the production of synovial sarcoma established in this series, but in some instances a contributory relationship appeared to exist between the development of the malignant synovioma and such a factor as trauma. In 3 of our patients it seemed definitely evident to us that the malignant synovioma was preceded by a benign tumor, but this is not a common relationship. Most of the malignant synoviomas arise in tissues adjacent to the articular surfaces or in extra-articular sites, from tendon sheaths and bursa. The articular surfaces themselves are infrequently involved by malignant synoviomas. The most frequent locations for the malignant synoviomas are the foot and the knee. The duration of symptoms in all patients in this series from onset until adequate therapy was instituted averaged over 22 months, which is the longest period of culpability for delay in the treatment of any malignant tumor in our experience. The initial symptoms were either the presence of a painless mass, the presence of a painful mass, and pain without any mass followed in a variable period by the presence of a detectable tumor.

The synoviomas may be pseudo-encapsulated, but the so-called capsule contains tumor cells and enucleation is fraught with the hazards of imminent recurrence. The synovioma early tends to invade adjacent muscles and tendons, and for this reason local surgical dissection, however radical, is seldom adequate and amputation usually ensues in due time. The adjacent bone is eroded by pressure and contributes to the tenderness of the tumor.

The microscopic features of the synovioma vary from alveolar structures sometimes with papillomatous growths simulating mesothelial structures to regions that are myxosarcomatous containing clefts lined by mesothelium. Other instances occur in which the tumor is extremely cellular, anaplastic and highly malignant without differentiation that would enable the pathologist to determine the histogenesis. Finally, a large fibrosarcomatous element may constitute 40 to 60 per cent of the bulk of the actual malignant tumor.

The malignant synovioma usually metastasizes by means of the blood stream and the most frequent location for metastatic deposits is in the lungs. Pulmonary metastases were observed in 65 per cent of patients. The average time from treatment until pulmonic metastases became evident was 16 months. Even after the 5 year interval of freedom from evidence of the disease, pulmonary metastases may still make a delayed appearance. Involvement of regional lymph nodes by metastases through the lymphatic routes was observed in 16.6 per cent of our patients. Metastases to bone have occurred in 8 per cent of patients.

Synovial sarcomas are notorious for the high incidence of recurrence which develops subsequent to initial attempts at exitrpating the neoplasms. As years

have gone by, amputation has been substituted in a higher percentage of cases over radical local dissection on the realization of the futility of the latter operation. A recurrence rate of 63.3 per cent was observed and 26.6 per cent of the patients developed a second recurrence after attempts were made at local excision. The 5 year survival rate for malignant synovioma, without recurrence in the interval, was 21.6 per cent.

Rhabdomyosarcoma of Skeletal Muscle: In earlier years it was asserted that true tumors of skeletal muscle did not occur, and that these neoplasms originated from the connective tissue septa within the muscle bundles, but it is now evident from selective staining that true rhabdomyosarcomas do exist although of relatively infrequent occurrence. This report is based on 100 consecutive cases of rhabdomyosarcomas treated on the Mixed Tumor Service at the Memorial Cancer Center.

The tumors of the muscle group are divided into (a) non-myoblastic tumors involving skeletal muscles such as sarcomas developing in myositis ossificans, parosteal bone sarcomas, fibrosarcomas and so forth, and (b) true myoblastic tumors of the skeletal and other striated muscles which include teratomas and mixed cell tumors of various organs such as testes, kidney, ovary and prostate, sarcoma botryoides of the uterovaginal canal, congenital myoblastomas of the tongue and of the cardiac muscle and the malignant myoblastic tumors of skeletal muscle as described by Abrikossoff, which tumors constitute the body of this report. The rhabdomyosarcomas occur with greater frequency in men; for example, 61 men to 39 women in our experience. This tumor is found predominantly in the middle and older age groups, with 65 per cent occurring in the 40 to 70 year age bracket.

The tumor appears in two forms, infiltrating and encapsulating varieties, but the distinction is of academic rather than of clinical interest inasmuch as the operation of enucleation of these tumors has been relegated into a historical background. Hemorrhagic necrosis in the rhabdomyosarcoma may be massive and give the lesion the appearance of a large hematoma. One other distinctive feature of the rhabdomyosarcoma in our experience has been that the tumor nodules are sometimes multiple, and this has lent support to the thesis that the origin may be multicentric. This modifies the concept of surgical treatment, embodying as it now does the necessity for complete removal of all of the muscle groups involved by the tumor. One of the most important features of the rhabdomyosarcoma from a microscopic diagnostic viewpoint is the presence of fibrils, chiefly crossed-striations. They are not always readily recognized. Embryonal rhabdomyosarcomas occur with some frequency in the head and neck in children and adolescents, in which subjects they involve the region of the orbit, the tonsil, the soft palate, the internal ear and the mastoid region. They have not been included in this group of patients for statistical analysis, inasmuch as their behavior differs from the ordinary rhabdomyosarcoma of skeletal muscle. The patients dying of this tumor came 4 months earlier than those patients who were cured; this paradox is explained by the fact that the more highly malignant sarcomas grew more rapidly, induced greater apprehension in the patients, and caused them to report earlier for treatment.

In the treatment of rhabdomyosarcoma it has become apparent through the years that if the tumor occurs on the trunk or on an extremity and local dissection is necessary and is chosen in lieu of a possible amputation, it is most necessary to remove all of the muscle groups involved from the point of insertion to the point of origin; none of the bundles of the related muscles should be preserved regardless of the degree of sacrifice, else local recurrence is the rule.

The cure rate for rhabdomyosarcoma is 35.3 per cent of 5 year survivals without recurrence in the interval. In studying the end results of therapy we found that if recurrence develops following a local conservative procedure, the patient does not necessarily lose his life because 14 of 31 such patients, or 45.2 per cent, with recurrent operable rhabdomyosarcoma were living and well 5 years after they applied to us for treatment. This 5 year survival rate is even higher than was obtained in the group of patients with primary operable rhabdomyosarcomas in which we had the first opportunity for treatment.

Liposarcoma: The 105 cases of liposarcoma in this report constitute 14.6 per cent of all sarcomas of the soft somatic tissues. Although malignant lipogenic tumors may develop in pre-existing benign lipomas as have occurred in our experience, the majority of liposarcomas originate de novo. Lipomas are not constantly found in association with liposarcomas. In our experience the ratio of benign lipomas to liposarcomas is approximately 120 to 1. There have been a few instances in our experience where local injury with ecchymosis has preceded the appearance of this tumor at the site of injury, but we attribute to injury only a very minor role in the causation of the average liposarcoma. The pseudoencapsulation of the average liposarcoma suggests its benignity and tempts the first surgeon unwisely to perform a simple enucleation. The primary liposarcoma often is situated deeply in the intermuscular or periarticular planes rather than in the subcutaneous location.

The classification of liposarcoma which we employ is to divide the tumors into two groups, namely: (1) adult cell liposarcomas in which the neoplastic cells are considered to be derivatives of adult fat cells resulting in large polyhedral granular cells, spindle cells and occasional giant cells, and (2) embryonal myxoliposarcoma, which tumor simulates the embryonal growth of fat tissue and often is associated with a peculiar proliferating capillary vascular system. The latter type usually is quite radiosensitive.

The radiosensitivity of liposarcoma varies inasmuch as the primary tumors often are quite radiosensitive and the recurrent liposarcoma, which tends to infiltrate and because of its invasiveness requires a vascular supply more adequately provided, is more resistant. The radiosensitivity of the liposarcoma usually is greater than the radiocurability. Of 12 liposarcomas treated entirely by irradiation only 2 (16.6 per cent) were sterilized; 60 per cent of the patients treated showed an appreciable regression of the tumor under radiation therapy and in 15 per cent of the patients the liposarcomas underwent complete clinical disappearance. However, microscopic foci showed residual sarcoma in the majority of the surgical specimens subsequently removed.

In the surgical treatment of liposarcomas, radical surgical dissection is feasible provided the proper rules are employed concerning the width and depth of dissec-

tion and the ruthless removal of surrounding tissues. The same laws of amputation apply as for other sarcomas involving the extremities.

End results of treatment of liposarcoma: Of the total cases, primary and recurrent, operable and inoperable, of liposarcoma under our care 67.7 per cent were suitable for surgical resection, that is, operable. Of these, 26.7 per cent were primary operable and 33.3 per cent were recurrent operable. Of the patients followed for 5 years classified as determinate and suitable for analysis, the definitive cure rate was 35.9 per cent; 8 of our patients have been cured for more than 10 years.

Malignant Neurilemoma of Peripheral Nerves: Malignant neurilemomas, neurogenic sarcomas, neurosarcomas and malignant schwannomas are synonymous terms for malignant peripheral nerve tumors that can be traced to the Schwann cells of the nerve sheath. The terms "neurogenic sarcoma", and "neurosarcoma" are hardly proper inasmuch as the tumor is not of the nerve tissue proper but of the nerve sheath. These tumors are found in patients who may or may not have the classic or abortive types of von Recklinghausen's disease. These tumors are so designated because of their origin from nerves arising either from named nerve trunks or their branches or in other benign nerve tumors. They are separated from other sarcomas of the soft somatic parts by their anatomic origin, much less certainly by their histologic structure. They differ from the other sarcomas because of their tendency to proliferate along nerves. The tumor may occur in isolated instances in which even close examination will not reveal the patient to have any stigmas of the forme fruste type of neurofibromatosis. Regardless of the association, the behavior of these malignant tumors is in no way different. To make a diagnosis of malignant nerve tumor of the type under discussion, the tumor must be shown to arise in definite nerve tissues. This appears obvious in view of the fact that both Schwann cells of the nerve sheath and fibroblasts can form reticulin or connective tissue fibers. So-called palisading of the nuclei appearing in malignant neurilemomas is also a characteristic of leiomyomas and leiomyosarcomas. The malignant nerve tumors of low histologic grading offer a good prognosis despite the frequent high recurrence rate. Those tumors with a high degree of anaplasia are almost invariably fatal, because of the great frequency of metastases despite the most radical methods of extirpation. Those patients having malignant neurilemomas which apparently develop de novo have a therapeutic curability of approximately 30 per cent, but the cure rate for malignant neurilemomas developing in patients with evident neurofibromatosis is infinitely higher, bringing the survival rate up to 59.4 per cent. The benign encapsulated neurilemoma or schwannoma is found in about 18 per cent of patients with von Recklinghausen's disease. The site of predilection for malignant neurilemomas is apparently in extremities with the upper extremity being more frequently involved. In reviewing the surgical findings and gross anatomic dissections of these tumors, the major nerve trunks are demonstrated in frequency of involvement in 17 cases as follows:

Median	5
Sciatic	2

Ulna	2
Radial	1
Brachial plexus	3
Femoral	1
Peroneal nerve	3

Malignant neurilemoma originating in plexiform neurilemoma or elephantiasis neuromatosa was noted in 12 cases.

The malignant peripheral nerve tumors should be treated by surgical measures, either by radical local resection or by amputation when necessary. Each case represents a separate problem and the surgical procedure must be individualized to fit the local setting.

Kaposi's Idiopathic Hemorrhagic Sarcoma: Kaposi's disease is a condition which, in its incipiency, goes through an intermediate stage suggesting a relationship with a granulomatous or infectious process in much the same fashion as Hodgkin's disease. It is a complex sarcoma of essential vascular structure which tends to occur in people of certain bodily habitus. It occurs preponderantly in males as there have been only 3 instances of the tumor occurring in women, in our experience. It usually begins on the extremities involving both legs in multicentric foci. The majority of these patients have short legs from knee to ankle with flat feet and long standing vascular disturbances prior to the onset of the tumors. There is a racial predilection in that it seems to occur more frequently in peoples inhabiting the Mediterranean basins and in the Slavic and Chinese races. The pre-existing vascular disturbances, such as varicosities and lymphedema of the extremities may be of etiologic significance. We have observed its development in patients who have had long standing pedal lymphedema secondary to proved infestation by filariasis. The identical tumor histologically is seen in the upper extremity in the lymphedematous or swollen arm, or the so-called surgical elephantiasis secondary to radical mastectomy. This type of so-called lymphangiosarcoma of the lymphedematous arm, which nearly always is in females because of the preponderance of breast cancer, probably originates in the same manner as the typical Kaposi's sarcoma of the lower extremity.

The tumor has three stages in its evolution. The first phase is the muscular phase in which there is ectasia of the blood vessels with lymphocytic infiltration. The second stage or granulomatous phase is characterized by the onset of nodularities which under the microscope bear clinical resemblance to any of the granulomas, specific and nonspecific. The neoplastic phase is characterized by the confluence of these nodules into a superficial tumor of the skin and subcutaneous tissues. The histologic elements taking part in these tumors are congeries of connective tissue, peripheral nerve elements and angiomatous elements such as the blood vessels, endothelium, smooth muscle cells and so forth. Starting on the feet, the nodules may become confluent and new ones develop upward along the extremities until finally visceral metastases occur after many years, resulting ultimately in the death of the patient.

If only a few nodules of the tumor are found, simple surgical excision and primary wound closure is the method of choice. When the disease becomes more

TABLE 1

End results in treatment of sarcomas of the soft somatic tissues

Type of Sarcoma	Percentage Distribution	Five Year Cure Rate (Percentage)
Total cases	100	39.2
Sarcomas (undetermined histogenesis)	36.4	40.8
Liposarcoma	14.6	35.9
Rhabdomyosarcoma	13.9	35.3
Malignant synovioma	8.4	21.6
Kaposi's sarcoma	6.7	28.6
Malignant neurilemoma	6.4	59.4
Fibrosarcoma	5.4	55.6
Dermatofibrosarcoma protuberans	5.4	69.2
Angiosarcoma	2.6	27.3

widespread then the individual nodules may be treated by low voltage contact x-ray therapy or by the application of radium in the form of small plaques at relatively short radium-skin distances. Prolonged palliation by the judicious use of these agents may be anticipated. The 5 year survival without recurrence in the interval, in our experience, has been 28.6 per cent. Although many patients are living for more than 5 years, the majority at no time have been free of clinical evidence of the sarcoma.

Pack and Davis have reported some instances of the concomitant occurrence of Kaposi's sarcoma with the classical type of malignant lymphoma and with Brill-Symmers giant follicular lymphoma. Those who have observed the clinicopathologic phenomenon of these two disease processes present in one individual, may form the opinion that there are some related or common causal factors. These same factors also are of significance in favor of those who adhere to the reticulo-endothelial origin of Kaposi's disease.

Sarcomas of the Soft Somatic Tissues in Infants and Children: Sarcomas of the soft somatic tissues in infants and children represent an histologic and clinical entity which, although not common, represents, nevertheless, one of the major forms of cancer in the developing infant and child. Certain distinguishing characteristics between cancer in the younger individual and cancer in the older individual have become apparent. For example, the ratio of sarcomas to carcinomas is much greater in children than in adults; certain organs are the hosts for cancers in children more frequently than adults. Certain embryonal tumors or teratomas may appear histologically benign, but clinically are highly malignant, while others such as melanomas in children usually are benign clinically although they may demonstrate a high degree of malignancy on the basis of histologic criteria. Malignant tumors as a rule do seem to grow more readily in the very young without evoking a protective objection by the host.

The treatment of sarcomas of the soft somatic tissues of children in this series should dispel the pessimistic attitude to this important subject. It should encourage every effort to treat each case of childhood cancer because cures can be obtained. The 5 year cure rate of all determinate cases treated for sarcomas of

the soft somatic tissues is 42.1 per cent. The highest mortality occurred in patients who bore sarcomas of the lower extremity, shoulder and torso.

Analysis of the end results in relation to the age of the patient reveals that the best prognosis apparently was enjoyed by 9 of our patients under 1 year of age; only 1 of these 9 patients died from the sarcoma, 3 are alive and free of evidence less than 5 years after treatment and an additional 3 are alive and free of evidence 5 years or longer after treatment.

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THE USE OF REFRIGERATION ANESTHESIA (REGIONAL HYPOTHERMIA) FOR AMPUTATION IN POOR-RISK PATIENTS WITH PERIPHERAL VASCULAR DISEASES

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INTRODUCTION

Refrigeration anesthesia has been used for amputation procedures in poor-risk patients since it was first described by Allen[1] in 1941. At that time, he demonstrated that by packing a diseased extremity in ice it could be physiologically separated from the remainder of the body as preparation for amputation. Others[2, 3] have since called attention to the use of "ice anesthesia" in selected

It has been shown previously by Allen[1] that hypothermia of the tissues will bring about a marked decrease in protoplasmic irritability and slow down the usual metabolic activity of the tissue cells. The adverse effect of cold on the healing of tissue has not been such as to decrease the value of refrigeration anesthesia.

Because of the recent advances in methods for anesthesia, especially in the elderly and poor-risk patients, the use of cryoanesthesia has decreased. It remains, however, the anesthesia of choice in certain cases. In an effort to re-evaluate the use of refrigeration anesthesia for amputation in patients with advanced peripheral vascular disease, we have reviewed the cases of a series of patients who have had amputation of extremities under regional hypothermia anesthesia and compared them with a larger group of patients whose amputations were performed under spinal anesthesia. The amputations were done over a one year period in the Roper Hospital.

INDICATIONS

Patients for amputation of extremities under refrigeration anesthesia were selected after consideration of all the disease factors involved, as well as the age and general metabolic state of the patient. Particular advantages of refrigeration anesthesia were as follows:

1. In the diabetic patient there is no interruption of the diet or oral intake of carbohydrates before or after anesthesia. No modification of the insulin schedule is necessary. Of particular importance is the diabetic patient who is in severe acidosis or who is a difficult problem because of uncontrolled infection secondary to gangrenous tissue. Physiologic amputation, using ice-packs and a tourniquet, yields dramatic benefits in this group of patients.

2. The presence of febrile toxic states frequently is a factor in patients who have gangrene of an extremity associated with secondary infection or bacteremia. The use of physiological amputation of an extremity with tourniquet and ice-packs, followed several days later by amputation under refrigeration anesthesia, is often life-saving.

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3. Many of the patients requiring amputation of arteriosclerotic gangrene have, in addition, ischemic changes in the cardiac, renal or cerebral tissues. For these reasons they may be poor anesthetic risks but will tolerate the refrigeration methods because there is no associated hypotension, anoxia or vomiting.

METHODS

The patients to have amputation performed under refrigeration anesthesia were selected according to the previously described criteria. As a group they presented a greater anesthesia risk than those whose amputation was performed under spinal anesthesia.

Preoperative care was administered according to metabolic or infectious changes present. The diabetic patients were carried on their usual diabetic diets and insulin requirements both before and after operation. The gangrenous and infected areas on the extremities were treated locally with dry or moist dressings as indicated. Antibiotics were given according to the type of infection present. When toxic and severe metabolic symptoms (fever, uncontrolled diabetes, mental disturbance caused by the infection, and others) were present, the limb was packed in ice to a level just distal to the point where amputation was anticipated. After the extremity became partially anesthetized a tourniquet was placed at the upper limits of the ice-pack. These patients were afebrile and much improved generally by the day of operation.

Although previous technics described for refrigeration anesthesia have placed the site of tourniquet application from 1 to 15 cm. proximal to the anticipated amputatioe level, we prefer to place the tourniquet 5 cm. distal to the line of the skin incision. In general the level for amputation is selected and the extremity is placed in crushed ice up to this level for 30 to 60 minutes. Usually at this time an arterial tourniquet, composed of rubber tubing 10 mm. in diameter, is encircled around the extremity twice and held in place either with a ligature or some type of clamp which does not encroach upon the skin. Care must be taken not to pinch or twist the skin during the application of the tourniquet. At times it is necessary for relief of pain to give morphine just prior to the application of the tourniquet. Then the extremity is replaced in the bed of crushed ice where it can be left for 48 to 72 hours or longer, depending upon the state of decomposition. The crushed ice should completely cover the extremity at all times without the excessive collection of water from melting ice or causing the bed to become wet. This is accomplished by use of a water-proof box as shown in figure 1. It is important that this box be placed so that the inlet is slightly lower than the extremity. An outlet hose in the distal end of the box will drain the water as it forms. If such a box is unavailable a satisfactory substitute can be made by wrapping the entire extremity with some form of water-proofed material with dependent drainage to allow for the excess water. This dressing can be made from usual materials found on a surgical ward. It is important that the ice be flaked or chipped rather than cubed. The level of ice must extend up to and include the tourniquet. The patient must be advised that once the tourniquet and ice are applied there is no recourse except amputation. It was anticipated at first that these patients would object to the application of ice and tourniquet to the ex-

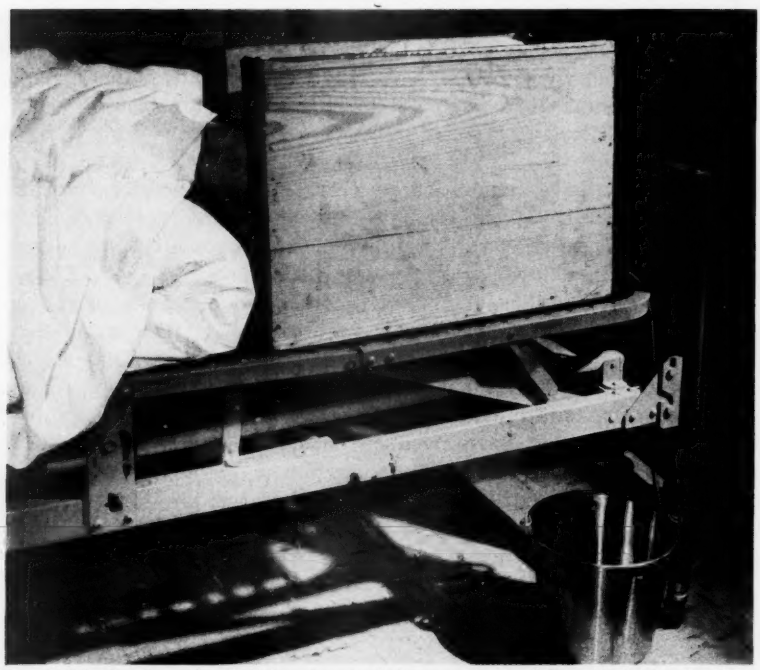

FIG. 1. Wooden box, lined with galvanized tin, complete with padded inlet for the extremity and an exit tube for the escape of ice water. This box, containing the extremity and chipped ice, is placed directly on the bed springs for stability.

tremity; however, it was found that because of the prolonged pain which had been present, associated with high fever and general malaise, they were grateful for the relief offered by the physiologic amputation.

Once the tourniquet has been applied the patient can be deliberately prepared for the operation during the next few days. Those patients with uncontrolled diabetes are very easy to regulate, those with heart failure can be managed, and those with severe toxic symptoms from their infection and necrosis rapidly recover systemic stability.

When ice anesthesia is to be used during operation it is necessary to extend the level of crushed ice 6 or 8 inches above the anticipated amputation site for a period of 1½ to 3 hours, depending upon the level of amputation and the thickness of the tissue involved. The ideal temperature at the site of operation is 68 to 70 F.

In the operating room the ice packing is removed just prior to preparation of the operative field. It is unnecessary to use chilled instruments or cold saline solution for irrigation purposes. The anesthesia lasts approximately 1 hour. On several occasions it was necessary to supplement cryoanesthesia with a small amount of 1 per cent novocain injected into the large nerves at the level of the

amputation. This is needed only in patients with insufficient refrigeration or prolonged operating time.

The temperatures of the amputated stumps were recorded by a thermocouple immediately after the limbs were removed. Routinely the stump of the amputated limb was immobilized and a firm dressing was applied. It was then allowed to return gradually to room temperature without applying ice packs.

Sutures were removed on the tenth to fourteenth day, depending upon the rate of healing. The bandages were not removed or the wound examined until 5 to 7 days after operation unless there was some special indication. Rubber drains were not used.

Patients given spinal anesthesia received the usual preoperative medication. Either procaine or pontocaine solutions were used as the anesthetic agent. Postoperative care was essentially the same as that described above.

CHART I

No.	Name	Location	Result	Temperatures (Fahrenheit)				Diagnosis
				Skin	Muscle	Bone	Room.	
1	B. M.	Supracondylar	Healed; dischgd 12th day.	Not recorded				Arteriosclerosis and diabetes
2	W. C.	Below knee	Necrotic stump; reamputated; dischgd 45th day.	60°	58°	64°	79°	Arteriosclerosis
3	A. W.	Below knee	Healed slowly; dischgd 12th day.	69°	66°	68°	80°	Arteriosclerosis and diabetes
4	C. T.	Below knee	Necrotic stump; reamputated; dischgd 24th day.	69°	69°	71°	91°	Arteriosclerosis
5	J. D.	Below knee	Healed slowly; dischgd 12th day.	Not recorded				Arteriosclerosis
6	A. R.	Below knee	Healed slowly; dischgd 3 months.	72°	67°	70°	88°	Arteriosclerosis and diabetes
7	J. B.	Below knee	Healed slowly; dischgd 20th day.	Not recorded				Arteriosclerosis and diabetes
8	F. G.	Supracondylar	Healed slowly, guillotine type: dischgd 30th day.	Not recorded				Ca. with metastasis and ischemia
9	E. S.	Below knee	Died 2nd day.	66°	63°	65°	80°	Arteriosclerosis with embolus and gangrene
10	E. B.	Below knee	Discharged 19th day.	69°	70°	67°	75°	Arteriosclerosis and diabetes

RESULTS

There were 10 patients with amputations performed under ice anesthesia. Two of these were done as supracondylar type of operation and the remaining 8 were performed below the knee. In 2 instances the ice anesthesia had to be supplemented by local novocain in the larger nerve trunks. There was 1 postoperative death in this group when a poor-risk cardiac patient died on the second postoperative day because of congestive heart failure. The average postoperative hospital stay was 28 days varying from 12 to 90 days, depending upon the condition of the individual patient. All of these patients were poor-risk anesthesia candidates and presented advanced age, generalized arteriosclerosis, heart disease, or diabetes associated with severe infection and gangrene as complicating factors. At the time of operation the skin temperatures in the amputed stump ranged from 60 F. to 72 F. The muscle temperatures varied from 58 F. to 70 F.,

CHART II

No.	Name	Location	Result	Anesthesia	Diagnosis
1	L. B.	Transmetatarsal	15 days later below knee necessary (infection)	Spinal	Diabetes and arteriosclerosis
2	J. S.	Transmetatarsal	Discharged 19th day	Spinal	Arteriosclerosis and gangrene
3	B. J. M.	Below knee	Discharged 22nd day	Spinal	Diabetes with arteriosclerosis
4	R. C.	Below knee	Discharged 7th day	Spinal	Old traumatic ulcer with osteo.
5	M. T.	Thigh	Died 2nd P-O day	Spinal	Postembolus; gangrene; arteriosclerosis
6	A. E.	Transmetatarsal	Discharged 17th day	Spinal	Diabetes; gas gangrene
7	J. J. R.	Below knee revision	Discharged 11th day	Spinal	Diabetes; arteriosclerosis
8	T. B.	Below knee	Discharged 15th day	Spinal	Arteriosclerosis with gangrene
9	L. M.	Below knee	Healed slowly. Discharged 2 mos.	Spinal	Arteriosclerosis with gangrene
10	R. Mc.	Below knee	Healed slowly. Discharged 49th day	Spinal	Arteriosclerosis with gangrene
11	E. L.	Below knee	Poor healing. Reamputated; discharged 25th day	Spinal	Diabetes and arteriosclerosis
12	C. B.	Below knee	Discharged 37th day	Spinal	Arteriosclerosis; gangrene
13	I. B.	Below knee	Discharge l 33rd day	Spinal	Diabetes and arteriosclerosis
14	D. B.	Below knee	Poor healing. Reamputated; discharged 44th day	Spinal	Arteriosclerosis; gangrene

and the bone was recorded at 64 to 71 F. There was no correlation of degree of coldness with effectiveness of anesthesia in the ranges of temperature noted. Of 8 patients who had below-the-knee amputation only 2 presented sufficient lack of healing to necessitate higher amputation.

The second series, consisting of 14 patients with gangrenous extremities, were operated upon using spinal anesthesia. Ice was neither used as preparation for operation nor as an anesthetic agent. Satisfactory operative anesthesia was obtained in all patients. Postoperative care was essentially identical to that of the first series. There were 3 transmetatarsal amputations in this group, 1 of which had to be revised with a higher amputation. One amputation in this series done under spinal anesthesia was at a high thigh level but the remaining 10 were all below the knee. Because of ischemia and secondary infection, 2 of this group of 10 had to be amputated at a supracondylar level. The average hospital stay in this series was 26 days.

DISCUSSION

While the number of cases involved in this study is too small to afford unequivocal statements, we gathered several distinct impressions. In the preparation of these seriously ill patients for amputation, the application of crushed ice and tourniquet to the extremity allowed simple control of the infection and relief of pain. The length of time to prepare these patients for operation as compared to other methods was decreased by several days.

Unless the house and nursing staffs are thoroughly familiar with the objectives in preparing these patients with ice-pack and tourniquet, almost insurmountable problems arise. The constant melting of the ice, allowing water to seep into the bed clothing and mattress, is upsetting to all concerned. The almost constant observation to see that ice entirely covers the extremity is a problem when the box previously described is not used. However, when such a water-proof box as pictured in figure 1 is constructed by the hospital carpenters, and when the staff has been properly instructed as to its use and function, the problems are minimal.

It is noted that the temperature at the level of amputation is lower than that which is used in general hypothermia for cardiac operations. This temperature is not low enough to produce frost-bite nor is it applied for sufficient lengths of time above the tourniquet level to produce injury to the tissues. In no instance was there evidence of necrosis to the skin or its underlying muscles. In the 10 patients who had below-the-knee amputation under spinal anesthesia there were 2 in whom supracondylar amputations were later indicated because of loss of tissue at the amputation site. In the 8 patients who had below-the-knee amputation using ice anesthesia, 2 were later subjected to a supracondylar amputation because of loss of tissue.

In the 22 patients described, no operations were done as urgent or emergency procedures. If the patient could not be prepared satisfactorily using routine measures, the ice anesthesia and tourniquet were applied so that deliberate preparation could be managed. No patient was deemed too ill for operation.

Those patients who had ice anesthesia for amputation had no vasomotor, respiratory, gastrointestinal, or genitourinary complications with the exception of 1 patient who, on the second postoperative day, died with acute pulmonary edema.

In those patients who had spinal anesthesia for the operation, there was occasional lowering of blood pressure during anesthesia. In addition urinary retention and mild paralytic ileus occasionally occurred postoperatively. None of these complications in this particular group of patients were severe.

In this group of patients the ice-packs were extended several inches above the site for amputation 2 or 3 hours before operation. However, this, is unnecessary, of course, if the operator or anesthetist prefers some other type of anesthesia. Thus the ice-pack and tourniquet can be used for preparing the patient for amputation and, in addition, it may be used as the anesthetic agent for operation.

SUMMARY

In order to compare local hypothermia as an anesthetic agent to spinal anesthesia during the amputation of extremities in patients with severe peripheral vascular diseases, 24 patients with similar ages and diseases were selected for a controlled study. Of the 10 patients who were operated upon under ice anesthesia, there was no evidence to indicate that tissue damage or delayed healing resulted because of the anesthesia. The 2 to 4 days' preparation of the infected gangrenous limb by the use of ice and a tourniquet as a physiologic amputation in several of these patients was life-saving. The average length of hospitalization of patients in whom ice anesthesia was used was 28 days as compared to 26 days in those patients who were subjected to spinal anesthesia. There were fewer annoying complications such as nausea, vomiting, ileus and urinary retention in the group of patients who had ice anesthesia.

CONCLUSIONS

Local hypothermia (refrigeration anesthesia) is not only an excellent adjunct in the preparation of patients who are seriously ill because of infected gangrenous extremities, but can be used safely as the anesthesia of choice in the same group of patients. The rate of healing in the amputated stump was essentially the same as in a similar group of patients who were operated upon under spinal anesthesia during similar circumstances.

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INTRAMEDULLARY FIXATION OF LONG BONE FRACTURES*

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INTRODUCTION

In the opinion of the author, the most important development in the treatment of fractures in the over 20 years that he has been practicing Orthopaedic Surgery, is the use of intramedullary fixation. It has revolutionized the treatment of fractures of the femur and has been very helpful in several other regions, especially in the tibia and clavicle.

Twenty-five years ago, there were three classical methods of treating fractures. The first of these was by means of closed reduction and the use of a cast. The second method was by means of traction. The third method was by means of an open reduction and internal fixation with some type of fixation device, the most common one being a plate and screws. Later in the treatment of fractures, a method employing pin fixation by means of pins placed through both fragments and then incorporating these pins in either a cast or with connecting bars was added. The latest method of fracture treatment to be added is by means of intramedullary fixation. This is sufficiently different from other methods to warrant calling it a separate method.

Historically the first intramedullary fixation was performed by Lambotte in 1902 in which he used it in a clavicle. In 1939, Rush, in this country started treating fractures of the femur by means of intramedullary rods. Kuntcher, in Germany in 1940, started treating fractures of the femur with his intramedullary nail. Later on, Kuntcher extended the use of his nail to the other long bones. Hansen and Street reported on the use of their diamond shaped intramedullary femoral nail in 1947.

GENERAL REMARKS

This paper will deal primarily with fractures of the femur and tibia which are the two places where its use is well established and where it seems to work the best. Some remarks will be made on its use in other places, particularly the clavicle and forearm.

Generally speaking, intramedullary fixation of fractures of the femur represents an ideal method of fixing this fracture. Intramedullary fixation has increased the percentages of union with the first attempt to treat the fracture satisfactorily from 65 per cent with traction to 95 per cent with intramedullary fixation. As a matter of fact most skilled orthopaedic surgeons employing the Hansen-Street nail will come very close to obtaining 100 per cent union. The author has employed the Hansen-Street nail for intramedullary fixation of fractures of the femur, since 1949 with excellent results.

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In the tibia, the best intramedullary device is that designed by Lottes. The statistics on intramedullary fixation when compared with other methods are very imposing here also.

The use of intramedullary pins in the forearm generally is satisfactory, and the author personally employs it rather frequently. In the clavicle, intramedullary pinning is an excellent method of treatment when it becomes necessary to do an open reduction. Generally speaking, fractures of the humerus are not satisfactorily treated by means of an intramedullary device. The metacarpals and metatarsals may be treated by means of intramedullary fixation, but usually they can be as well or sometimes better treated by other methods.

The basic principal of treatment in intramedullary fixation is sliding fixation allowing end to end impaction of the fragments. This impaction apparently is very important in producing union.

THE FEMUR

The Hansen-Street nail has been found to be a highly satisfactory method of treatment and has been used exclusively by us since 1949 for intramedullary fixation. This nail is diamond shaped in cross section and comes in two sizes. The regular size, which is the larger, is used for almost all cases. Occasionally in a very small person, or one who has a very small medullary canal, the smaller diameter nail is required. However, it is not nearly as strong as the regular size nail.

Street reported a series of 100 cases in which the Hansen-Street nail was used with good results in fractures of the shaft of the femur. His statistical research was done carefully and represented consecutive cases of several different surgeons including 12 cases done by this author. Union in his series was 100 per cent of the 100 cases.

Open reduction in the intramedullary nailing of fractures of the femur is advisable in order to do the procedure exactly, to save time, and to minimize shock. Another important factor is that many roentgen ray exposures or much fluoroscopic examination is necessary for a closed reduction. There are outstanding objections to both methods of roentgenographic examination and an open reduction actually is more conservative than trying to attempt a so-called blind nailing.

As soon as the fracture is opened a preliminary reduction is done to make sure how the fragments of bone will fit together and to visualize the handling of any large, comminuted fragments. It is my usual practice to drill the medullary canal up through the trochanter using a long extension drill 2 millimeters smaller than the diameter of the pin. This procedure is followed to prevent the tip of the trochanter from being fractured as the nail goes through this region. However, Dr. Street and many others believe that this is seldom necessary. If the isthmus of the femur or any other part of it seems too small to receive the nail, the region should be broached by means of the special broaching tool made for this purpose.

The fracture is now ready to nail. A nail is selected which is long enough to extend at least 4½ and preferably 5 inches past the fracture site. The nail should

extend down to within 2 inches of the knee joint, and this is a most important consideration in selecting nail length. After the proper nail is selected it is driven up the shaft of the femur until it is felt under the skin of the buttock. An incision is made in this area and the nail is driven further upward until about ¼ inch still protrudes at the fracture site. As the nail is driven upward it comes out through the incision made in the buttock for this purpose. The fracture is now reduced accurately and held in position while the nail is driven back across the fracture site downward into the distal end of the femur. It is desirable to have only a small amount of nail projecting above the trochanter, preferably between ½ and ¾ of an inch. No cast is necessary after insertion of the nail. In fact, the addition of the cast will constitute a serious complication and may cause delayed or nonunion.

If comminution is present and no major fragments can be held to maintain length, intramedullary nailing is not applicable. Communited fractures may be screwed together with screws extending across the sides at the periphery of the circumference of the femur. These screws, when screwed down tightly convert the middle loose pieces into one major fragment. The nail then may be passed through this fragment and into the distal fragment.

The question of how high or how low a fracture may be and still be suitable for nailing has not been finally settled. It is my opinion that 4½ inches from either end of the femur is generally the lower limit of length permissible.

A possible complication is accidental bending of the nail during convalescence. Usually a bent rod may be straightened in a closed procedure under general anesthesia without serious difficulty.

The patient should bear a moderate amount of his weight on the femur for the first 6 weeks. After this he can begin to bear most or all of his weight on it depending on the appearance of the roentgenograms. Six to 10 weeks usually is the length of time required before full weight bearing is begun. How long the nail should be left in is another controversial point. In the aged or debilitated where it would seem undesirable to submit the patient to even a minor additional procedure, the nail should be left in. In younger, healthy patients, it is believed that the nail should be removed in 2 years. If the roentgenograms do not show solid union at this time it should be left in even longer.

I use the original Hansen-Street nail, slightly modified with an eye at each end so that the nail can be pulled out if it should become stuck while being driven upward through the proximal fragment. The instruments necessary for using the nail, are three small fittings which may be screwed to the end of an ordinary Smith-Peterson nail director (or handle). One device has a hollow end which fits over the nail and is used as a driver. Another has a hook on the end and is used as a simple extractor. The third has a U shaped end through which passes a heavy cotter pin. This device is used for removing nails when they have become stuck.

It is my opinion that the Hansen-Street nail has revolutionized the treatment of fractures of the shaft of the femur and that it is the best method of treatment for most cases. The clover leaf nail is another device which when used properly

is a good method of nailing femoral shaft fractures. The original Kuntcher nail has not worked well in this country for a variety of reasons, the chief one being that it is not heavy enough. Rush pins are used by some fracture surgeons but they are not generally as satisfactory as the Hansen-Street nail principally because they are round and not diamond shaped.

Considerable writing has been concerned with the so-called fluffy callus observed around fractures of the femur treated by intramedullary fixation. This callus is supposed to be soft and take a long time to consolidate. Although sometimes a large amount of callus forms, I have not seen any softness. Furthermore, if a dark line appears across the callus, weight bearing need not be prohibited, and if continued the fracture will go ahead and unite almost always.

The comfort enjoyed by the patient and his ability to engage in ambulation are important points in this method of treatment of fractures of the femur. One thing I would like to emphasize is that this method of treatment is not suitable for use in children. Usually the lower age of applicability is 12 to 14.

I reviewed 75 cases of fractures of the femur treated by means of the Hansen-Street nail. In this series, there was one nonunion. In addition to this, there were 3 cases of delayed union in which solid union had not occurred within 9 months. All 3 of these cases however went on to subsequent union without any further operative procedure being done. Thus it will be observed that our percentage of union in fractures we have treated by means of the Hansen-Street intramedullary nail has been very high. Added to the high percentage of union there are the advantages of immediate ambulation with crutches, and the lack of use of a cast.

THE TIBIA

The Lottes' nail is employed by us exclusively for intramedullary fixation of the shaft of the tibia. We do not treat all fractures of the tibia by means of intramedullary nailing, however. I also believe that if internal fixation is needed, where intramedullary fixation can reasonably and safely be employed, it is superior to other methods of treatment. Intramedullary fixation is valuable in cases of delayed union and nonunion also.

The Lottes' nail was designed by its inventor for the purpose of making a better nail for intramedullary nailing in the tibia. The V nail of Kuntcher was not exactly the right shape nor was it quite heavy enough. The cross section of the tibia is roughly triangular in shape during its entire length. The Lottes' nail is triangular in shape. Each end of the nail has a bend in it for the purpose of facilitating its insertion. The distal end is bent slightly so that it will follow the path down the medullary canal of the tibia after it has been started from above. The upper end is bent slightly, so that as the nail is driven home the upper end will conform to the portal of entry of the nail and to the shaft below and beneath it. Lottes has given a good deal of thought as to the hardness of the nail and it is just a little malleable so that it will straighten as it goes down the shaft of the tibia and into the distal area.

The details as to the insertion of this nail are quite important. The patient is

placed on a fracture table and the involved extremity put up in strong traction. The knee is flexed 60 degrees or more. The fracture then is reduced by applying strong traction and lining it up properly. An incision is made over the anterior aspect of the broad surface of the tibia opposite the tibial tuberosity. After exposing the tibia a large size drill hole is placed for the purpose of making a portal of entry for the nail. This hole is placed quite obliquely. The fracture site is not opened unless the fracture proves incapable of being reduced closed. It is seldom necessary to open the fracture.

Prior to starting the operation careful measurements are taken on the opposite leg from the tibial tuberosity to the internal malleolus. Based on this measurement a nail of suitable size is selected. The driver handle is screwed onto the end of the nail and the nail started down the medullary canal of the shaft of the tibia. As this is begun great care is taken to have the anterior aspect of the nail directed exactly anteriorly so that its triangular shape is exactly comparable with the triangular shape of the tibia. The nail is next driven down the shaft of the tibia. As it approaches the fracture site an assistant very carefully and forcibly holds the fracture reduced and the nail is driven across the fracture site into the distal fragment. Roentgenograms then are made under sterile technic. The fracture is checked as to reduction and the nail checked as to location and length. If the nail appears to be a little too short an extension made for this purpose may be applied to the proximal end of the nail and the nail driven in a little further.

The wound is closed in the usual manner. A cast is applied from the toes to the midthigh with the leg straight. The reason for applying the cast is to prevent accidental bending of the nail during the first part of convalescent treatment. The cast also puts the extremity at rest and cuts down immediate postoperative pain. We in our office frequently employ a moulded leather brace at the end of 6 weeks to further protect the nail from bending at the fracture site.

Weight bearing in these cases is most important. The patient should bear about 50 pounds of weight on his leg after the first 2 weeks and should gradually increase his weight bearing. At 6 weeks full weight bearing usually is started either in a cast or in a moulded leather brace.

When the nail should be removed has not been entirely settled as yet. We remove the nail in patients under 45 in all cases, or I should say we urge that it be removed. In older individuals it probably is all right to leave the nail in place indefinitely.

As to the indications and contraindications for the use of the intramedullary nail in the tibia, there are very few contraindications. Severe communition where excessive shortening might occur is a deterrent to the use of this method. Lottes himself, believes that compound fractures should be treated by means of this intramedullary nail rather than by more conservative means.

As far as statistics are concerned we have done 26 cases by means of the intramedullary nail and have had 26 consecutive unions. It is not meant to be implied that we always will have 100 per cent union, but it is believed that the percentage of union will exceed 90 to 95 per cent.

THE FOREARM

The author of this paper has tried a number of intramedullary devices in the forearm and has used round pins the most The reason for this is that both the radius and ulna change their configuration in cross section as they go down from proximal to distal. In other words both the radius and ulna are triangular in shape in some places and square in others, and diamond shaped in others and round in still others. A round pin will fit all of these different cross sectional configurations.

The author himself employs a partially threaded pin. The proximal 2 inches of the pin are threaded with threads which are over-sized as compared to the rest of the shaft of the pin. There is an obvious advantage to this in that it prevents the pin from slipping in or out once it has been placed in position and the oversized threads engaged in bone. The pins in the forearm have a marked tendency to migrate unless they are held in position in some way, and the oversized threads constitute a simple device for accomplishing this.

The description of how these pins are employed is as follows. An open reduction is done. The bone ends then are cleaned and curetted if necessary. Provisional reduction should be done to make sure that the fracture can be reduced satisfactorily. Next the pin is passed up and down the bone the full length of the open medullary canal to make sure that it fits properly and the canal is open.

In the ulna the pin then is drilled out retrograde into and through the olecranon. An incision then is made in the skin to allow it to come out posterior to the olecranon. The fracture then is reduced. An accurate measurement of the required length of pin is made, and the pin cut to length. The pointed end is next made dull by means of a file. It then is passed into the olecranon and down the shaft of the ulna to the fracture site. The fracture is reduced and the pin continues on down as far as desired. The last portion of the introduction of the pin is accomplished by means of the hand drill and screwing the threaded portion of the pin into the olecranon region where it is securely held by the oversized threads.

In doing the radius, the approach is somewhat different. An incision is made over the radial styloid and a path carefully established from here up into the medullary canal of the radius. This is accomplished by first using a very small pin, and then passing successively larger pins up the same path and gradually increasing the size until the regular size pin is reached. Here again the length of the pin should be carefully measured and the pin should be cut off to length and its end dulled with a file. It then is passed on up into position in the same manner as described for the ulna except for the port of entry and the bone involved.

Postoperatively anterior and posterior molded splints are applied for 2 to 3 weeks. Following this, the patient is encouraged to use his fingers and hand moderately extensively. This encourages end to end impaction and prompt union.

Severe comminution constitutes a contraindication in the use of this method. Other contraindications are gross contamination in a compound fracture and the fracture being too near the end of the bone.

Before leaving the subject of intramedullary fixation of the forearm, I would like to mention Dr. Dana Street's new square pins. These are a symmetrical shape and therefore fit pretty much uniformly. They have the added advantage that they prevent rotation when fitted snugly. Dr. Street's preliminary reports on these square nails are very encouraging.

THE CLAVICLE

The use of intramedullary fixation in the clavicle is a very satisfactory method of treatment when an open reduction is indicated. Open reduction with accurate fixation of this fracture is not required very often. In the average individual with a fractured clavicle, a satisfactory reduction can be obtained by means of a T splint, or some similar method. Union usually occurs in a high percentage of these cases.

However, when the fracture cannot be reduced at least fairly satisfactorily or where there is obviously going to be a very marked prominence of the bone at the fracture site following union because of an upward projection of the distal end of the proximal fragments, open reduction usually is indicated. In younger women and girls, a good anatomic reduction is necessary for cosmetic reasons. In general it may be said that an open reduction of a clavicle in our own experience is required in something less than 25 per cent of cases in adults.

For intramedullary fixation of the clavicle we use the partially threaded round pin with the oversized threads on one end. This is the same pin we use for the forearm. The technic of open reduction in these fractures is very similar to that employed in both bones of the forearm. The fracture site is opened and a provisional reduction done. Both ends of the medullary canal then are drilled out. Next a pin is drilled out from the fracture site, through the posterior aspect of the shoulder and out through an incision in the skin. The correct length of the pin then is determined and the pin cut off to length. The end is rounded by means of a file. The pin then is put in position starting from distally and running proximally across the fracture site. Care must be taken to be sure that no portion of the threaded part of the pin is across the fracture site. Another precaution is to be sure that there is at least a little drilled out space in the medullary canal proximal to the proximal end of the pin. This is to allow end to end impaction.

Following the operation a rather light type of Velpeau dressing is usually used for 2 weeks. The hand and arm may be used for light work in 3 or 4 weeks. Union usually occurs promptly, and most cases are solidly united in 6 to 8 weeks. The percentage of nonunion when employing this method of treatment is very low.

OTHER BONES

Metacarpals may be fairly satisfactorily treated by means of intramedullary fixation, by means of a small pin. The bone usually is entered at its distal end near the joint and the pin passed up proximally. Usually an open reduction is required to get accurate reduction while passing the pin across the fracture site.

As a whole the use of intramedullary fixation in metacarpals is not as good as

might be expected. Relatively simple methods of internal fixation may be employed in these fractures and a high percentage of union expected. Intramedullary fixation has a disadvantage of pinning the aponeurosis of the metacarpal-phalangeal joint down to the underlying bone. Because of this the pin must be removed quite early to allow mobilization of the joint. This constitutes an objection to the method.

Metatarsals may be treated by means of intramedullary fixation. It is not necessary to go into a detailed discussion of this for the remarks made above in regard to the treatment of fractures of the metacarpals, apply almost exactly to fractures of the metatarsals.

Fractures of the phalanges may be treated by means of intramedullary fixation in certain cases. However, here again the pin must enter the bone end at or near a joint and the aponeurosis around the joint is caused to adhere to the underlying bone. This constitutes a definite disadvantage. Other methods of internal fixation often are better. Besides this, many fractures of the fingers can be treated without open reduction, with union anticipated in a high percentage of cases and with good end results.

I would like to discuss the treatment of fractures of the shaft of the humerus by means of intramedullary fixation, principally for the purpose of stating my opposition to this method of treatment. The shaft of the humerus is not entirely straight but instead bends in several places. In cross section it is not the same in shape or configuration at different levels. Because of this a round pin is best if one is used at all. With a round pin in the humerus, considerable rotation may occur and this is conducive to nonunion.

Nonunion with intramedullary fixation of the humerus is relatively common. Probably the principal reason for this is that there is a constant distracting force on the humerus during the course of union rather than an impacting one. In the tibia and femur, the patient bears weight on his extremity and causes the ends of the bones to be driven together, whereas in the humerus there is constant gentle traction with dis-traction of the bone ends due to the weight of the elbow or forearm hanging down all of the time. Fixation by means of a plate and screws generally is superior to intramedullary fixation in the humerus if an open reduction is indicated.

COMMENT

Intramedullary fixation is excellent in fractures of the femur, it is good in fractures of the tibia and clavicle, it is of some value in the forearm, it may be of some use at times in fractures of metatarsals and metacarpals, and in general is not indicated anywhere else. It generally is not satisfactory for fractures of the humerus, although there may be an occasional case where it works well.

In situations where intramedullary fixation works well its advantages are very great. The prolonged use of a cast is not required, and in fact in fractures of the femur it is not required at all and is contraindicated. Early ambulation is permitted in both fractures of the femur and tibia. In fractures of the forearm and clavicle, immediate early use of the involved extremity for light work is possible

and is even desirable. Intramedullary fixation has revolutionized the treatment of fractures of the femur and has been a great advantage in the treatment of certain other fractures.

SUMMARY

A general review and a brief history of the development of the use of intramedullary fixation of long bone fractures is given.

In the treatment of fractures of the shaft of the femur, intramedullary fixation has proved to be a revolutionary method of treatment. A very high percentage of union occurs. Early ambulation is permitted, and a cast is not used. The author prefers the Hansen-Street nail to other devices here.

In the treatment of fractures of the shaft of the tibia, the Lottes' nail is an excellent method of treatment, and has been used by the author with excellent results.

In the treatment of fractures of the clavicle when an open reduction is required, intramedullary fixation is the best method of treatment. Good fixation is secured and a high percentage of union is obtained if careful attention is paid to technic.

In fractures of the forearm, intramedullary fixation has some usefulness. The special partially threaded round pins, Street's new square pins, or certain other intramedullary devices may be used. Here its definite superiority over other methods of treatment has not been established.

In the treatment of fractures of the shafts of the metacarpals and metatarsals intramedullary fixation may sometimes be useful. As a whole, other methods of treatment are as good or better in these locations.

In general, intramedullary fixation of fractures of the shaft of the humerus is not a satisfactory method of treatment.

The author's statistics on intramedullary fixation are briefly reviewed.

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SURGERY OF THE NODULAR THYROID GLAND

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Nodular enlargements of the thyroid gland seem to have taken on an added significance as the seat of pathologic conditions of increasing conjecture. In the medical literature in the past 10 years a heated debate is in progress concerning the proper surgical procedure for the eradication of carcinoma. In many areas of this country there has been a marked increase in the incidence of lymphocytic thyroiditis, the 'so-called' Gulf Coast thyroiditis. Perhaps then by obtaining a large number of reports concerning these conditions from various areas, some concrete ideas may be formulated which will eventually aid in the diagnosis and treatment. It was thought that a study of these lesions including all nodular growths of the thyroid gland would allow such deductions to be more accurately drawn.

In this review, all cases of nodular thyroid enlargements admitted to the Mississippi Baptist Hospital and St. Dominic's Hospital, Jackson, Mississippi from 1951–1955 inclusive, have been recorded. With the exception of all cases of acute and subacute thyroiditis and a few cases of chronic thyroiditis, all of these patients were treated surgically. The area from which these cases were derived, largely from central Mississippi, is not an endemic goitre area.

Table 1 reveals that 521 such cases were encountered during this five year period. Of these, 84 were by clinical symptoms, metabolic studies, as well as pathologic confirmation found to be toxic nodular growths. The remainder (437) were nontoxic multinodular growths including 242 nontoxic nodular goitres, 74 true solitary benign nodular, 70 thyroiditis, and 51 malignancies of the thyroid gland including 24 solitary malignant nodules. Of the 242 multinodular growths, 64 were diagnosed preoperatively as being solitary nodular.

The indications for thyroidectomy in nontoxic multinodular thyroids are:

1. The prevention of thyrotoxicosis. Since it is known that 35 to 50 per cent of nodular goitres will become toxic over a period of 10 to 15 years and that the onset of toxicity is so insidious that cardiac damage has occurred before the cause, or the toxic symptoms, have become manifest, it is thought that this alone is ample cause for removal.

2. The incidence of malignancy in this series considering the entire nodular group is 9.9 per cent. If the cases of toxic multinodular thyroids, in which the incidence of carcinoma is low, as well as the thyroiditis cases are excluded, the incidence is then 12.1 per cent.

3. Cosmetic reasons alone are ample indications for thyroidectomy in many of the large unsightly lesions.

4. Pressure symptoms, although they are infrequently of such extent as to

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TABLE 1

Nodular thyroids

Benign		
Multinodular Toxic Thyroids		84
Multinodular Nontoxic Thyroids		242
Solitary Nodular Thyroids		74
Thyroiditis		70
Acute	5	
Subacute	12	
Reidel's	12	
Lymphocytic	41	
Malignant Thyroids		51*
Papillary	33	
Nonpapillary	13	
Angioinvasive adenoma	3	
Hurthle cell	2	

* Includes 24 malignant solitary nodules

cause undue concern, nevertheless will occasionally warrant the removal of such a gland.

5. Substernal or intrathoracic descent of a nodular growth usually is preceded by sufficient symptoms to cause removal before the extra cervical portion of the gland causes notable difficulties.

Multinodular thyrotoxicosis is accompanied by a very poor response to usual iodide and antithyroid therapy preoperatively. It may be necessary to give large doses of propyl thiouracil up to 1200–1500 mg. daily in order to shorten the preoperative preparation period. On occasions intravenous sodium iodide, 1 gram daily, given in a liter of fluid may greatly aid in preparing the refractory patient for surgery. However, once the patient has been properly prepared and the surgery adequately performed, the recurrence rate is very low and the results very satisfactory.

Solitary nodular thyroids in this series of cases revealed 24.4 per cent to be malignant. There were 24 malignancies out of a total of 98 patients with solitary nodular thyroid disease. This in itself is a more commanding indication for surgery than for a solitary lump in the breast where only 1 case in 16 or approximately 6 per cent are found to be malignant.

Thyroiditis particularly the subacute and lymphocytic (Gulf Coast) types apparently are being diagnosed with increasing frequency within the past 5 years. Hashimoto's thyroiditis formerly considered as rare, differs from the lymphocytic variety only in that the oxyphilic cells are not found in the latter. The destruction of the normal thyroid gland and the lymphocytic replacement accompanied by low metabolic rate and clinical hypothyroidism seem similar in both conditions. It is believed by some that these glands represent repeated episodes of low grade hyperthyroidism in which the hyperplastic areas become 'burned out' and are replaced by lymphocytic replacement. There were 41 cases of lymphocytic thyroiditis encountered. In the first 2 years of this report they were diag-

nosed as Hashimoto's thyroiditis, but a review of these slides failed to reveal the oxyphilic cells. This represents 7.8 per cent of the total.

Riedel's thyroiditis, 12 in number, does not seem to show an increase. Surgery usually is performed on lymphocytic and Riedel's thyroiditis to exclude cancer or to relieve pressure symptoms. The isthmus and anterior third of each lobe should suffice to relieve pressure symptoms. These patients will require thyroid therapy for hypothyroidism following surgery, but they would have required the same medication without surgery due to destruction of the functioning portion of the gland. Approximately 3 trains of thyroid daily are required to prevent symptoms.

Acute thyroiditis is a surgical entity only when abscess formation occurs and then only incision and drainage is indicated. Nodular enlargement accompanied by tenderness of the thyroid gland, fever of low grade, pain radiating to the upper neck and ears, malaise, joint and muscular pains is indicative of subacute thyroiditis. Acthar gel and radiation therapy are the current methods of treatment and surgery is contraindicated.

The greatest difference of opinion seems to evolve about the proper treatment of carcinoma of the thyroid which spreads beyond its containing capsule and to the regional nodes. There are those who believe that a modified neck dissection preserving the sternomastoid muscles and avoiding disfigurement will suffice in papillary growths. At the same time a larger or more numerous group believes that this is an inadequate operation and that a true radical neck dissection on the involved side and occasionally on both sides is a necessity. Still another group states that neck dissection should be accompanied by a sternal splitting incision and cleaning out the superior mediastinum to which these lesions spread. The latter report included only 9 cases and within 3 years 4 of the 9 patients were dead, so it would seem at least that when spread has occurred to the superior mediastinum, it must certainly have gone byond these limits and that such a procedure would not be worthwhile as a routine procedure. Actually, it seems that the difference in opinion in the former two conditions probably is brought about by the fact that papillary adenocarcinomas are notable, in many instances, of slow growth and spread so that the adequacy of the modified neck dissection may be misleading.

In this series of cases there were 51 malignancies, of these 33 were papillary adenocarcinomas, and 10 or approximately $\frac{1}{3}$ of these showed cervical node metastasis, including the so called lateral aberrant thyroid, at the time of surgery. Twenty-four occurred as solitary nodules. In 4 other patients in whom only total lobectomy was performed at the time of surgery metastases have occurred within 3 years.

This would indicate that 9.9 per cent of the total nodular growths were malignant. A breakdown further revealed that if one excludes toxic nodular goitres which have a very low incidence of malignancy (there were 4 in this series) and thyroiditis (2 in this series) that the incidence of malignancies in nontoxic nodular thyroids is 12.1 per cent. This figure is of such magnitude that it alone should demand the removal of the nodular goitre.

The incidence of malignancy in the solitary nodule in this series was difficult to ascertain in so far as preoperative diagnosis is concerned. As one can see, there were only 74 solitary nodules of the thyroid gland in the nonmalignant group. However, there were 64 of the nontoxic multinodular growths that were preoperatively diagnosed as solitary nodular. If one utilizes the total of 98 patients with solitary growths, 24 patients or 24.4 per cent were found to be malignant on pathologic examination. In diagnosing solitary nodules it is very difficult to make a definite diagnosis preoperatively. Firmness and induration of the nodule would tend to make carcinoma more likely. This, however, is not infallible since thyroiditis is apt to be firm and feel indurated also. Despite this difficulty, Cole reports a correct preoperative diagnosis in 75 per cent and Crile, Jr. 90 per cent in cases involving the solitary lesion.

Surgery of the solitary nodule should include adequate exposure of both lobes of the thyroid gland, frozen section, and subtotal or total lobectomy and removal of the isthmus on the involved side, even if the lesion is benign on frozen section. Sharp toothed clamps should be avoided, as well as removal of the nodule only, to prevent spread of carcinoma if present. The cervical node-bearing area should be carefully inspected for nodes and if these are suspicious a radical neck dissection should be done on that side. Total lobectomy usually will suffice for small lesions confined to one lobe when no metastasis is suspected in the cervical chain or the Delphian node. Surgery should be followed in all cases by radiation therapy. Bilateral lobectomy or total thyroidectomy will be necessary in about 7 per cent of patients in whom lesions are present bilaterally.

In nonpapillary adenocarcinomas, which are likely to spread by blood stream as well as by the lymphatics, lobectomy and radical neck dissection on the involved side is indicated. In these lesions, however, involving the surrounding structures incidence of distant metastasis is so likely that radical neck dissection is not indicated. These patients should have tracheotomy and radiation therapy. The same is true of giant cell carcinoma in which the prognosis is equally poor.

Iodine$_{131}$ may be of some assistance in some differentiated carcinomas but not the undifferentiated in which the outlook is hopeless.

Solitary nodular growths in children should be operated upon early as these are very likely to be malignant. Angio-invasive adenomas require only lobectomy as any spread is likely to be distant.

Intrathoracic Thyroids Growths: In the past 7 years we have had 14 intrathoracic nodules, the majority of which have been posterior mediastinal in position.

TABLE 2

Author	No. Patients with Nodular Goitre	No. Patients with Nodular Nontoxic Goitre	Per Cent Malignant Nodular Nontoxic	Per Cent Malignant in Solitary Nodular Goitre
Crile, Cleveland, 1948	537	274	10.9	24.5
Cole and associates, Chicago	663	285	17.1	24.4
Twente, Jackson, Miss., 1956	521*	242	12.1	24.4

* And thyroiditis.

The largest one was resting on the diaphragm, filling the lower one-half of the right pleural cavity.

Preoperative roentgenograms should be made of the chest in all nodular goitres to indicate the absence of substernal or intrathoracic descent.

In most of the substernal or intrathoracic goitres the collar incision will suffice, but in many particularly those occurring posteriorly combined cervical and thoracic incisions will more safely permit the delivery of the thoracic portion of the tumor. For the posterior lesion, too, a combination of a collar incision with resection of the third rib is superior to the sternum splitting incision as it gives better access to the lesion and is less traumatic.

CONCLUSIONS

The prompt surgical removal of the nontoxic nodular goitre is fully justified for two reasons. First the incidence of carcinoma is high, and second the percentage that will become toxic with an insidious onset is so great that these lesions should be removed.

2. Chronic thyroiditis should require surgery rarely, but then only to exclude carcinoma and to relieve pressure symptoms.

3. Adequate surgery for malignancies of the thyroid gland whether found in solitary or multinodular goitres should include true radical neck dissection where nodes are found to be suspicious or when there is capsule or blood vessel invasion.

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MALIGNANT METASTASIS TO THE LUMBAR SPINE SIMULATING DISK RUPTURE: REPORT OF TWO CASES

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The so-called *"classical"* history and physical findings of low lumbar disk rupture are common knowledge. The syndrome has been adequately described by Bradford and Spurling[2] in their monograph on the subject. The typical findings of a herniation of the nucleus pulposus, however, are not as pathognomonic as is currently believed. It is becoming more and more apparent that although ruptured disk is responsible for by far the greatest number of patients complaining of backache and sciatica, there is a large number of other lesions that will produce an identical clinical picture.

Among the lesions reported which have produced the disk syndrome are primary bone tumors of the lumbar spine, pelvis and femur, inflammatory processes within the spinal canal, spinal cord tumors, osteoarthritis, and congenital anomalies of the lumbosacral area. Another lesion which is known to mimic this condition is metastatic disease of the lumbar spine. Reports of such a situation are rather scarce in the American literature.

It is the purpose of this paper to review the American literature on this subject, to present 2 additional cases, and to suggest some ways in which the correct diagnosis might be made prior to surgery.

Odell and Key[9] recently have called attention to this problem. They reported the cases of 19 patients in whom the lumbar disk syndrome was present. Of these, 12 had metastasis to the lumbar vertebra. Seven had disk surgery prior to the recognition of the underlying disease, and in 3 of these the true diagnosis was established at the time of surgery. Each of the other 4 was reoperated upon before the real cause of pain became evident. Goldenburg[6] reported 4 cases. In 3 of these the diagnosis was not known preoperatively. Epstein[5] described 11 cases of epidural metastasis of which 9 had the admission diagnosis of ruptured lumbar disk. Two more cases have been added by Bosworth.[1] Echols and Rehfeldt[4] include 1 case of metastatic disease in a series of 32 operations for sciatica in which a herniation was not found. Craig, and associates,[3] in a series of 1,296 patients operated upon for intraspinal lesions at or below the level of the tenth thoracic vertebra, found that 51 had tumors. Twenty-four of these showed evidence of tumor initially. Two of these proved to be metastatic. Of the remaining 27, 20 had the working diagnosis of herniated nucleus pulposus. In 7 of the 27 tumor also was suspected initially either because of night pain, scoliosis or hyphoscoliosis, or the presence of a malignant lesion elsewhere in the body. In 22, elevation of the total protein of the cerebrospinal fluid above 100 mg. per 100 cc. aroused suspicion. Two of the 27 eventually proved to have metastasis, of which 1 was not recognized prior to surgery.

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We have seen 2 patients at Hermann Hospital with lumbar spine metastasis who were operated upon for disk rupture. Their cases are presented below.

CASE REPORTS

Case 1. A 37 year old white woman entered the hospital at 8:30 a.m. on Nov. 27, 1950, with the following history. On the evening prior to admission the patient had become nauseated, and while bending forward and vomiting, had experienced the sudden onset of sharp, low back pain. Within a short time the pain had radiated to the left hip, and then down the back of the thigh to the posterolateral aspect of the leg. The pain was aggravated by moving, straining, or coughing.

Physical examinatoin revealed bilateral lumbar paravertebral muscle spasm, more marked on the left, and without scoliosis. Straight leg raising was positive at 50 degrees on the right, 30 degrees on the left. Deep tendon reflexes were slightly hyperactive, and equal. There was no extensor weakness. Sensation was normal.

Admission laboratory data were normal. The hemoglobin was 15.7 Gm. per 100 cc. Roentgenograms of the lumbar spine were considered within normal limits.

Pelvis traction was instituted shortly after admission. This provided considerable relief by the fifth day. Definite left great toe extensor weakness was noted during the fourth hospital week. A myelogram done at that time was normal.

The patient was taken to surgery on December 22. Evidence of degenerative disk disease was found at the fourth lumbar interspace. The lumbosacral disk was considered normal. No disk material was removed at either level.

The postoperative course was uneventful, and the patient was relieved of her symptoms. She was discharged 2 weeks later. While at home she found a lump in her breast. This was biopsied and found to be malignant and a radical mastectomy for adenocarcinoma was done Soon following the mastectomy, pain in the hip and leg returned. Re-examination of the lumbar spine by roentgenogram on Feb. 2, 1951, was negative. Repeat myelography on February 21, showed a small, narrow column of oil overlying the body of the fifth lumbar vertebra. Reoperation on the same day revealed a bulging tumor mass at the lumbosacral level. A complete laminectomy was done to gain good exposure. Pathologic diagnosis was adenocarcinoma.

The sciatica was relieved, but within 3 weeks the patient began complaining of dorsal backache. Roentgenograms showed metastatic disease in the eighth thoracic vertebra. The patient was carried on narcotics. She died on March 27, 1951, 4 months after the onset of symptoms.

Case 2. A 61 year old white man was admitted to the hospital on Aug. 23, 1951. Six weeks previously he had been lifting some heavy trunks when he noted a *"catch"* in his low back. The pain persisted without radiation, slowly becoming more severe. and localizing over the lumbosacral joint. There was moderate, ill-defined numbness in both legs.

Physical examination disclosed mild lumbar paravertebral muscle spasm. Straight leg raising was positive at 30 degrees on the right, 45 degrees on the left. The right knee jerk was hyperactive, the left somewhat hyperactive. Both Achilles reflexes were absent.

Admission laboratory was normal. The hemoglobin was 16.1 Gm. per 100 cc. Roentgenograms of the lumbar spine made prior to admission were normal. A myelogram made the day after admission showed "persistent narrowing of the column of oil as it flowed into an elongated cul de sac. . . . There was also persistent indentation from the left upon the column at the fourth intervertebral disk level, and as the column flowed cephalad it persistently was broken up as it reached the 3rd disk level." Spot films made of the fourth lumbar vertebra showed slight erosion of the posterior aspect of its body.

Surgery for ruptured disk was done a few days later. Examination of the lumbosacral disk revealed only slight softening. Because of an anatomic peculiarity the L-4 disk had to be approached from the L-3-4 level. A large, bulging disk was found and removed. Review of the tissue sections showed no tumor. A Wilson type fusion was done from L-3 to the sacrum.

There was persistence of pain postoperatively. At the end of the second week the wound began to drain, and continued to do so for the rest of the patient's life. On November 24 rarefaction of the bodies of the third and fourth lumbar vertebra was noted. This was more evident 6 weeks later. By early February an osteolytic area was apparent in the region of the right acetabulum. The serum alkaline phosphatase was slightly elevated at this time. By early March, there was extensive metastatic activity present in the pelvis and upper femora. The patient died at home 8 months after the onset of symptoms.

At autopsy a primary carcinoma of the esophagus was found. The medullary portion of the upper sacrum and lower lumbar spine were replaced with tumor.

These 2 cases are more or less typical of the previously reported ones. The presence of malignancy was not suspected, even after surgery. How, then, can an accurate diagnosis be made prior to surgery?

In many of these patients routine roentgenologic study of the lumbar spine and pelvis will demonstrate the lesion, or at least arouse suspicion. Negative findings by no means rule out metastasis, however. Young and Funk[11] have pointed out that a surprisingly low percentage of roentgenograms of even extensively involved spines will show visible changes. In their series, only 13 of 30 grossly diseased specimens showed changes on contact roentgenograms. Lichtenstein[8] also has shown that even though the vertebral body be riddled with tumor, it may appear entirely normal. It is suggested that especially in older patients—40 and beyond—with the disk syndrome, painstaking study of the lumbar spine be carried out. Any suspicious area, no matter how insignificant it may appear, deserves re-examination by means of spot views.

Epstein reported a myelographic finding that may be of value. In 7 of his 11 cases the myelogram "showed the caudal sac to have a tapered appearance, resembling an inverted inclined cone of varying height deviated away from the lesion. . . ." Neither of our cases showed the configuration of the oil column he described.

The value of the determination of the serum alkaline phosphatase and of the erythrocyte sedimentation rate in detecting metastasis to bone has been shown by Wolfson and associates.[10] In osteoblastic lesions the serum phosphatase nearly always is elevated, while in osteolytic lesions, although it may be normal, it frequently is elevated.

The erythrocyte sedimentation rate is a sensitive reaction to cellular destruction. Other than pregnancy, infection and malignancy are the only conditions in which it is found elevated. If a rapid sedimentation rate is found, and pregnancy and infection can be excluded, malignancy must be considered. Kaump and associates[7] have found that it reaches its maximum rather rapidly, and does not increase with successive involvement of bone.

Determination of the total spinal fluid protein should always be done at the time of myelography, and if elevated above 100 mg. per 100 cc. additional studies to rule out tumor can be carried out.

In spite of the most conscientious efforts on the parts of the physician the diagnosis of lumbar spine metastasis frequently will be missed. An awareness of the problem, however, will aid in recognizing the disease process, and may lead to a more satisfactory choice of primary treatment. It is suggested that in any patient in whom there are suspicious roentgenologic findings, or in whom the

presence of a primary lesion elsewhere in the body is known or suspected, the determination of the serum alkaline phosphatase, erythrocyte sedimentation rate and total spinal fluid protein be carried out. Myelography should be performed routinely in the older age groups with the disk syndrome.

SUMMARY

A review of the cases of lumbar spine metastasis simulating ruptured disk that have appeared in the American literature has been presented. Two additional cases have been reported. Some of the difficulties encountered in arriving at the proper diagnosis have been pointed out, and helpful diagnostic technics employed by others have been reviewed.

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ANESTHESIA FOR THE AGED AND POOR-RISK PATIENT

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The number of surgical patients in the upper age group is growing steadily. The increase in the life expectancy of the American population and the change in attitude towards surgery in the aged are largely responsible for the increase. Patients heretofore considered inoperable are scheduled for formidable operations without hesitation. Improved preoperative preparation, postoperative care, refinements in surgical technic, and advancements in anesthesia have contributed considerably to the betterment of results.

The choice of anesthesia for any patient, whether young or old, is based upon physical status. Chronological age, usually, is no index of risk. Patients advanced in years often are in surprisingly good physical condition. The fact that they have survived so long may attest to a rigorous constitution. On the other hand, middle aged patients often appear older than they are in years and frequently are afflicted with serious medical complications which preclude a successful outcome of a contemplated procedure. Yet, even though evaluations are carefully made, offering a prognosis occasionally leads to embarrassment. A patient whose physical status is satisfactory and obviously should withstand a contemplated procedure without difficulty may die unexpectedly from a cerebral vascular accident, coronary thrombosis, pulmonary embolus, shock, acute heart failure or other unanticipated cause. Then, there is the patient who is an obvious poor risk, whose survival appears doubtful, who does surprisingly well. The element of uncertainty of outcome in patients of advanced age has not been eliminated in spite of medical advancements.

Clinical Factors Influencing Anesthesia in the Aged: Some of the clinical factors peculiar to patients in the older age group which bear directly upon the choice of anesthesia are these:

1. *Cardiovascular status.* Cardiovascular diseases particularly those characterized by loss of elasticity of the vessels are present in varying degrees in most patients of advanced age. Reflex adjustments to the demands for increased blood flow, changes in blood pressure, fluid loss, and alterations in blood volume do not occur as readily and with the ease they do in young patients. Coronary artery disease, arteriosclerosis and hypertension are common complications. Even though many surgical patients have heart disease death on the operating table from acute heart failure or coronary thrombosis is infrequent. Coronary thrombosis is more common in the postoperative period. Presumably thrombosis may be initiated during operation and manifests itself hours later.

2. *The blood volume* usually is reduced in the aged. Adjustment of blood volume

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is more difficult in older than in young patients. Vascular overload from excess blood, plasma, plasma volume expanders and intravenous solutions of electrolytes precipitate cardiac failure.

3. *The respiratory system* invariably shows signs of degenerative changes and reduces ventilatory function. Chronic pulmonary diseases further enhance the dysfunction. Particularly distressing, is chronic emphysema; the so-called *barrel chest* is familiar to all. The large functional residual air volume characteristic of emphysema causes inadequate ventilation and poor mixing of inhaled gases. This is particularly distressing to the anesthetist. The arterial oxygen tension is reduced and the blood carbon dioxide is elevated. Diaphragmatic movements are exaggerated and interfere with surgical manipulations, particularly in upper abdominal operations. Chronic inflammatory disease often is accompanied by suppuration. Secretions and purulent discharge are bothersome irrespective of the type of anesthetic employed. In addition coughing, laryngeal and bronchial spasm are common particularly where spasmogenic drugs such as the thiobarbiturates are used.

4. *Renal function* often is impaired. In most cases this is due to degenerative changes in the kidney, heart or blood vessels. Fluid, acid base, and electrolyte balance usually are disturbed.

5. *Nutrition* may be poor. Digestive disturbances often cause weight loss, emaciation and diminished muscle tonus. The venous system lacks the normal support of skeletal muscle to enhance the return of blood to the heart. This is an important factor in maintaining a normal circulatory system. Reduced serum proteins, vitamin deficiencies, or anemias may be present, all of which complicate problems of anesthesia. Anemia, particularly, requires correction because it is associated with a diminished blood volume and decreased gas transport by the blood. Obesity, so prominent in the middle aged group of patients is less prevalent in the aged. The life expectancy of the obese is not as long as that of the young. The obese patient is a poor risk from the standpoint of anesthesia. An open airway is difficult to maintain. Ventilation is impaired, even in the supine position, to say nothing of the prone, lateral and head down position.

6. *Derangements of function of the various glandular organs* may be present. Fibrosis and other degenerative changes of the liver may cause impairment of hepatic functions. The diminished tolerance of aged patients to nonvolatile drugs, particularly narcotics and hypnotics, is due in part, to diminished activity of detoxifying mechanisms. Prolonged somnolence and depression is common after the use of pentothal, avertin and the narcotics. The pancreas may undergo fibrotic changes. Diabetes may be present and complicate the picture with the disturbed metabolism and associated changes in the vascular system.

7. *Metabolic activity* is reduced. The metabolic rate declines gradually after the middle forties. The decreased metabolic rate and the decreased tolerance to narcotics and hypnotics are interrelated. Proportionally smaller doses are required compared to young adults.

8. *The nervous system* undergoes changes. Sclerosis of the cerebral vessels is

the most prominent change. Reflex activity is diminished. Involvement of the cerebrum, particularly, is outstanding because psychic disturbances are noticeable. Narcotics and hypnotics often enhance the psychic disturbances and cause excitement instead of sedation.

9. *The skeletal system* undergoes changes. Deformities, degenerative changes and arthritic processes in the bones and joints occur. Fusion of the vertebrae interferes with flexion and extension of the spine and affects proper positioning on the table, attempts at lumbar puncture or limits hyperextension of the head necessary for intratracheal intubation.

10. Many aged patients are *edentulous*. Difficulties are encountered in applying masks to the face for inhalation anesthesia. A tight fitting, closed system cannot be established and intratracheal intubation usually is necessary. The edentulate patient, however, is easily intubated.

11. The *recuperative powers* of the aged often are diminished. Wound healing is delayed. The convalescent period is longer, as a rule. Pulmonary complications and thrombo-embolic phenomena occur as a result of enforced inactivity. Drugs causing prolonged somnolence, generalized listlessness and inactivity are undesirable. Drugs and technics of anesthesia which are rapid acting and assure rapid recovery are more desirable and should be used. Hypoventilation, since it leads to postoperative respiratory complications, in both young and old, must be avoided. Early ambulation often is practiced in the aged to avoid postoperative circulatory and respiratory complications. Anesthesia must be selected with this view in mind. Doses of analgesics and hypnotics must be reduced to quantities which do not cause respiratory depression and inactivity in the postoperative period. For this reason, the combinations of drugs so commonly used in present day anesthesia practice are undesirable and technics embodying the use of single agents are preferred.

Unfortunately, each of the aforementioned factors rarely occur singly. Were it so the problems of anesthesia would be less complex. Instead, it is common to have several present simultaneously. This complicates the problem of selecting the proper anesthetic for a given patient. No rule of the thumb can be laid down because each case must be individualized.

Effects of Various Anesthetic Drugs in Aged Patients: Age per se, is no contraindication to the use of any anesthetic drug. The statement often is heard that this drug or that drug cannot be used for old patients. The emphasis is upon the age instead of the existing pathologic entity which contraindicates the use of a drug. It has been mentioned that old patients are less tolerant to all central nervous system depressants, both volatile and nonvolatile. Nitrous oxide or ethylene, for example, rarely yield satisfactory surgical anesthesia in young and vigorous individuals, unless accompanied by a certain degree of anoxia. Relaxation, without anoxia, on the other hand frequently is obtained when the gas is administered to aged patients. Both nitrous oxide and ethylene are suitable for patients in the older aged groups provided adequate oxygen concentrations are used with the gas. There are no contraindications to the use of these gases if these requirements are fulfilled. When this is not possible these

gases can be fortified by combining them with other volatile anesthetics or with small doses of basal narcotics, such as the barbiturates.

Cyclopropane, in the absence of cardiovascular disease, not only is suitable but desirable for the aged because it is labile, permits lightening and deepening of anesthesia at will. In addition, more than adequate concentrations of oxygen can be assured and moderate degrees of muscle relaxation are easily obtained. No serious physiologic or metabolic disturbances follow its use. The statement that cyclopropane cannot be used in the aged has no scientific basis. The more conservative anesthetists avoid the use of cyclopropane when cardiovascular diseases are present. Since this is a frequent medical complication in aged patients, opportunities for using cyclopropane are fewer than one might expect. Objections often are raised to the use of ether in the aged. The most valid objection to the use of ether in the aged is the slow recovery and prolonged period of somnolence. Since early ambulation is desirable, ether is a drawback in this respect. Nausea, vomiting and general discomfort occur more frequently after ether and restrict the patient's activity for a longer period immediately postoperatively. Ether enhances an existing acidosis to a greater extent than other currently used inhalation anesthetics.

The combination of cyclopropane and ether is used extensively by some anesthetists. In many ways it is an ideal combination for major surgical procedures. The induction of anesthesia is made pleasant and rapid with cyclopropane. Struggling, excitement, spasm and other disagreeable characteristics of induction of ether anesthesia are avoided. Ether then is added gradually. Cardiac disturbances, even in those who have diseased hearts, rarely develop during light cyclopropane anesthesia. Should they develop, they disappear as soon as ether is added. The ether also reflexly increases the tidal volume and causes an increase in the minute volume exchange. Considerable discussion is now heard concerning the diminished ventilation accompanying most forms of general anesthesia. Assisted and controlled breathing are advocated to compensate for this hypoventilation. Controlled breathing is artificial respiration. The word artificial is well selected because it describes exactly what is accomplished when it is applied to respiration. When voluntary respiratory efforts are made a negative intrathoracic pressure develops which serves the dual purpose of drawing air into the lungs and facilitates the return of venous blood to the heart. Failure to maintain an adequate venous return ultimately results in a decrease in cardiac output. All the effective methods of artificial respiration except that accomplished by the electrophrenic respirator rely upon a positive intrathoracic pressure for pulmonary filling. Thus, irrespective of the method employed for controlled respiration whether mechanical or manual, ventilation differs from normal breathing. In other words, no method of artificial respiration accomplishes ventilation as effectively as the patient's voluntary efforts. Ether is the only currently used "*major*" general anesthetic which does not cause some degree of hypoventilation. Minute volume exchange is normal or increased and the patient accomplishes adequate ventilatory exchange voluntarily. Then

also, when the combination of cyclopropane and ether is used, the quantity of each is reduced proportionately.

Vinyl ether may be suitable for surgical procedures of brief duration in the aged. It is not suitable for long procedures requiring deep anesthesia and muscle relaxation. Chloroform and ethyl chloride are not used irrespective of the prevailing conditions because they are cardiotoxic. Trichlorethylene may be used for analgesia but not surgical anesthesia. It may be used for painful manipulations such as the removal of dressings, application of casts, skin grafting and other such precedures not requiring loss of reflex activity.

Nonvolatile basal narcotics, such as avertin, paraldehyde and thiopental and similar barbiturates are not desirable and should be avoided because they often cause prolonged depression. Thiopental, evipal and surital are unsatisfactory as sole anesthetic agents. They should be combined with an analgesic such as nitrous oxide if they are used, since they lack analgesic power. The quantity of barbiturate is thus minimized. Muscle relaxants are best avoided or used with caution because they may cause respiratory failure, induce hypotension and are eliminated slowly. The tissues of most aged people are relaxed and often they are not necessary. Succinyl choline is preferable to other relaxants because its action is evanescent, due to rapid detoxification. Greater controllability and rapid recovery are permitted by using this drug.

Regional anesthesia serves admirably in many situations in surgery for the aged. There is, however, a deep-rooted impression that local anesthesia is the best in dealing with poor-risk patients. Certain operations cannot be performed properly with local anesthesia irrespective of the skill of the operator. There are other instances in which the available technic does not supply adequate anesthesia for a certain procedure irrespective of the skill of the anesthetist. In many instances when infiltration technics are used the operator succeeds only after using quantities of the anesthetic drug far above the safe limit or after employing a variety of intravenous hypnotics, narcotics and ultimately inhalation anesthesia to complete his procedure. Whenever possible, field blocks are preferable to local infiltration. Anesthesia is extensive and complete and the total quantity of drug used is much less than that required for infiltration. The writer is aware of instances in which 3 and 4 grams of procaine have been infiltrated in attempts to obtain adequate anesthesia, the operator being ignorant of the fact that the upper limit of dosage of procaine should not exceed 1 gram. The aged do not tolerate these drugs as well as young adults for several reasons: 1. They do not detoxify them as readily. 2. Local anesthetics depress the heart and reduce cardiac output, particularly if cardiac disease exists. Hypotension is not uncommon when excessive quantities of local anesthetics are injected.

Among the useful nerve blocks which one may employ are brachial plexus block for operations of the upper extremity, cervical plexus block for operations of the neck, lower intercostal nerve block or abdominal field block for abdominal surgery, and combined femerol and sciatic block for procedures on the

lower extremity. Combining epinephrine with a local anesthetic for procedures on the toes and the fingers is not safe practice. Gangrene may occur particularly when peripheral vascular disease is present.

Spinal anesthesia is ideal when no well defined cardiovascular derangement is present. As a rule *"low spinal"* anesthesia is tolerated reasonably well even by patients who show mild impairment of the cardiovascular system. Obvious and serious cardiovascular disease is a contraindication. The aged do not tolerate circulatory derangements caused by high spinal anesthesia as well as young patients. Hypotension, which appears in patients of all ages during spinal anesthesia, usually is more severe and its onset more abrupt in the aged. Vasopressor drugs are not always effective in the aged. The response may be fleeting and not sustained.

The psychosomatic aspect of spinal anesthesia must not be overlooked particularly in senile, disoriented and noncooperative subjects. Supplementation with narcotics or barbiturates often adds to the difficulty if small doses are used or causes respiratory depression if basal narcotic doses are administered.

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ABDOMINAL PREGNANCY: REPORT OF FOUR CASES*

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There has been an increasing number of reports of abdominal pregnancy in recent years. This attests for increasing success in management and may be attributed in a large degree to the advances in anesthesia, surgical technic, blood banks, and antibiotics. The term "abdominal pregnancy" is used to denote a gestation of 22 months or longer. Broomes reviewed the literature up to 1949 and noted that 337 cases of abdominal pregnancy had been reported.[1] Since then numerous reports in the world literature bring the total over 400.

The etiology and pathogenesis of abdominal pregnancy have been well covered in many recent articles and no attempt will be made to discuss them except when pertinent. The cases reported are from different surgical services in a small general hospital. There were consultations among the authors with exchange of ideas and opinions. It is hoped that certain observations noted among these cases and management of the placenta will be of interest.

DIAGNOSIS

If anyone has had the unexpected experience of finding an abdominal pregnancy at the time of an anticipated cesarean section, he will be more aware of that possibility on subsequent occasions. Suspicion and alertness together with other unusual findings will put the attending physician on guard for an abdominal pregnancy.

During the early stage of abdominal pregnancy there may be symptoms of a ruptured tubal pregnancy; if the patient is queried along this line, a history suggestive of a ruptured tubal pregnancy may be obtained. Three of the 4 patients presented a history suggestive of a ruptured tubal pregnancy or tubal abortion. It appears that the effects of this rupture were not sufficient to warrant operative intervention at that time and bleeding became arrested with organization of the tissues and subsidence of symptoms. Later in pregnancy there may be abdominal pain and digestive disturbances caused by the fetal movements and encroachment of the placenta upon the abdominal organs. According to MacGregor these symptoms may be increased if the amniotic sac is not intact.[3] Bleeding about the placenta with accompanying pain may be present. This is due to placental detachment which apparently is the result of the placenta growing in an environment not as well protected from stress and strain as an intrauterine pregnancy.

On physical examination of the abdomen at term or near term the fetus may be felt more superficially and prominently without the interposed uterus. One

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or more limbs may seem to lie beyond the normal confines of the uterus. In the primipara the cervix is hard and elongated, and in the multipara it does not have the expected bogginess and vascularity. If the placenta is in the posterior culdesac, a doughy sensation is imparted to the examining fingers behind the cervix. A combination rectovaginal examination should be done at the same time.

One significant finding is the x-ray demonstration of a high transverse position of the fetus. The uterus and placenta also may be outlined separate from the fetus by x-ray films.

When term is reached the patient may have pains resembling false labor pains and examination will reveal absence of uterine contractions. Cross and associates[2] recommend the Pitocin test which appears to be a safe method of stimulating uterine contractions if properly used. They stated that this test is the most valuable aid in the diagnosis of an early abdominal pregnancy. Although the authors have not used it, it seems to be an excellent means of determining whether the fetus is within or outside the uterus.

Hysterograms carry dangers of embolism, infection, and hemorrhage and may precipitate premature delivery if the diagnosis of abdominal pregnancy is in error. For these reasons hysterograms are not recommended.

MANAGEMENT OF PLACENTA

The ideal termination of an abdominal pregnancy would be to have a living mother and baby along with removal of the placenta without its chances of causing morbidity and disabling sequelae. A number of recently reported cases have this ideal termination. The fetal mortality rate becomes less as term is approached. The maternal mortality has not been high but the maternal morbidity is relatively high in those patients in whom the placenta is not removed. It is agreed that the placenta in all patients cannot be removed but there appears to be increasing success in their removal in recent years. Formerly no attempt was made to remove the placenta and either it decreased in size and became innocuous or resulted less frequently in complications such as abscess formation, intestinal fistulas, and bowel obstruction.

The authors recommend removal of the placenta when the condition of the patient permits, when the facilities are adequate, and when the procedure is not hazardous. Evaluation of the patient's condition will help to determine her ability to withstand the shock which may accompany the removal of the placenta. The function of her heart and kidneys should be good. Anemia and dehydration, if present, should be corrected. By facilities being adequate is meant that good anesthetists, competent operating room personnel, ample equipment, and a blood bank are available. If the placenta involves an important structure such as the ureter, iliac vessels, or intestinal tract and it cannot be removed without irreparable injury, there should be no attempt to remove it. We have no hesitation to sacrifice all or part of the internal genital organs if necessary since we regard the presence of an abdominal placenta to be of a more serious consequence than the sacrifice of these organs. One or both ovaries should be left if possible.

The incision should give adequate exposure and should be extended above the umbilicus if necessary. Loss of blood must be anticipated and immediate replacement made. A large gauge needle in one of the ankle veins will facilitate blood transfusions.

The amniotic sac may or may not be intact. If it is intact, the dissection may proceed down to the placental attachments. There will be noted fibrinous adhesions between the bowel and the amniotic sac. These usually are easily released without necessitating ligatures. In one of our patients of 6½ months gestation it was possible to keep the amniotic sac intact until it with the contained fetus was well mobilized down to the placental attachment before the fetus was removed. After the fetus is delivered the placental attachments can be better noted. The decision is now made as to whether the placenta is to be removed or not. If removal is decided against, the amniotic sac is trimmed away. Cross and associates[2] quoted Torpin as recommending that no ligature should be placed around the umbilical cord because this may cause cyst formation. The abdomen should be closed without drains because they may invite bacteria to enter and spread about the placenta with possible abscess formation.

If the placenta is to be removed, the removal must be complete because incomplete removal may result in hemorrhage. The first step is to see what organs are involved with the placenta so as to decide if removal is feasible. The next step is to determine if the main blood supply can be controlled. The operator should not make an attempt to "pry loose" the edge of the placenta in order to see if it can be removed or not. The decision must be made beforehand. The experience in our 4 patients is limited to placental involvement of the internal genital organs, rectum, appendix, cecum, distal ileum, and parietal peritoneum.

Individual patients will vary as to the exact involvement of the organs and structures and cannot be treated surgically alike, but there seems to be a strong tendency for the internal genital organs to be primarily involved. This was true in our patients and appears to be true in the great majority of other reports. The central portion of the placenta usually is very densely adhered in the region of one of the tubes. We believe that this area of densely adhered placenta represents the original site of rupture which has subsequently become scarred by healing. About this area the main blood vessels are located. This point is brought out because if the main blood supply at the central portion can be controlled by excision and suture ligatures, then the bleeding about the peripheral portions usually can be controlled by pressure packs or shallow sutures.

The operator may be in a dilemma as to where to begin his dissection. As stated above each patient will have to be individualized. It is best to delineate vital structures such as the iliac vessels, distal colon, ureter, and bladder or bear their proximity in mind so that injury can be avoided. If the tube and ovary on one side are involved, control first of the ovarian vessels in the infundibulopelvic ligament would be the more logical step. If only the tube is involved, the blood supply through the mesosalpinx is controlled. The fundus of the uterus with one tube or one tube and ovary may be involved, and re-

moval of the fundus with the tube and, if necessary, its ovary can be done. In one of our patients there was extensive attachment of the placenta about the posterior culdesac, rectum, and posterior right broad ligament in which the tube and ovary were obscured. In this patient it was easier to liberate the mass by freeing the tube, ovary, and uterus on the right side by ligating the ovarian and uterine vessels, next transecting the cervix (with due regards to the bladder and ureters) and then securing the uterine vessels with clamps on the opposite side. By this method the pelvic organs with the placental mass were removed. This may be the only practical solution since the placenta may be firmly wedged in the pelvis. In this way the main arteries, uterine and ovarian on both sides, are under control.

It is wise to use suture ligatures of chromic catgut as the dissection progresses so as to clear the operative field of unnecessary clamps. This will facilitate attempts to control sudden bleeding. By blunt dissection and careful divulsion of the placental tissue from subjacent tissues the mass is gradually liberated. Temporary control of bleeding sinuses can be effected by tamponade with a moist sponge pack held firmly in place by a Deaver or malleable retractor. Once the placenta is removed residual bleeding can be controlled by simple ligatures, temporary pressure packs, shallow "snaking" sutures of fine chromic catgut on an atraumatic needle or use of oxycel or gelfoam which can be tamponaded against the oozing site by fine catgut sutures. Care is always taken to prevent possible damage to vital structures. At times it may be wise to leave small bits of placental tissue in place rather than to attempt dissection and have annoying bleeding and possible encroachment on a vital structure. Ragged fibrinous tissue is trimmed away from the intestines or peritoneal lining. None of our patients had any dense bowel attachments in which bowel resection was necessary, nor was the bladder involved in any. Approximation of the peritoneum as well as possible over the remaining pelvic structures is carried out after the bleeding has been stopped. The abdominal wall is closed without drainage.

The question may be raised as to the use of ureteral catheters as an aid in identifying the ureters. The authors have not used them and have no objection if it will facilitate the operation. The trouble to insert them may be useless because the diagnosis could be in error or the placenta may not be near them. It would be best to identify the ureters if necessary under direct vision if the placenta has to be dissected near them.

We have not used bowel sterilization because we believe that with careful surgery the bowel should not be injured and if the involvement of the placenta is too extensive, the placenta should be left in place.

CASE REPORTS

Case 1. S. U., a 25 year old Negro woman, was admitted to the Orangeburg Regional Hospital on Nov. 3, 1948, complaining of having light irregular "labor pains" for 2 days. She had consulted here family physician who stated that her "baby" was dead and advised hospitalization. She felt no fetal movements for 24 hours prior to admission. Her last menstrual period was Feb. 10, 1948. She had a normal prenatal course. She did not experience any pain during her first trimester. Past history was noncontributory except for an uncompli-

cated appendectomy at the age of 13 years. She had two miscarriages and one living child. She attributed one miscarriage to a "fall" and the other to "kidney trouble".

On examination the patient was noted to be in moderate distress complaining of light "labor pains". Her skin was warm and dry. There was a moderate pallor of the conjunctiva. Her lungs were clear and the heart revealed no abnormalities. The blood pressure was 130/80. Although she complained of having light labor pains every 8 to 10 minutes no definite contractions were felt during examination. The fetal heart tones were absent and the position of the fetus could not be determined. There was no engagement of the presenting part and the cervix was not dilated.

Laboratory examination revealed hemoglobin, 51 per cent, total white blood cells were 9,000 per cu. mm. with 79 per cent polys and 21 per cent lymphs. Her Kline test and urinalysis were negative.

She made no progress during her first 4 days of hospitalization. She had "light pains" at irregular intervals. Her dehydration and anemia were corrected by parenteral fluids and transfusions. Roentgenogram of the pelvis was done and showed a full term fetus in the transverse position with the left elbow as the presenting part. There was no overlapping of the cranial bones. The maternal pelvic measurements were within normal limits. Because of the transverse position and lack of progress a cesarean section was recommended after consultation.

At operation on Nov. 27, 1948, an unexpected full term abdominal pregnancy was found. The amniotic sac was ruptured. A macerated female fetus was found lying free in the abdomen and was delivered. It weighed 12 pounds and no abnormalities were noted. The placenta was attached to the cecum, distal ileum, right posterior culdesac, the right ovary and tube, and the right posterolateral aspect of the fundus of the uterus. After the fetus was removed the patient went into profound shock. No attempt was made to remove the placenta and the abdomen was closed. She rapidly recovered from shock postoperatively with blood transfusions. She was discharged on the eighth postoperative day with a normal temperature.

She was followed as an outpatient at frequent intervals and during this time it was noted that the placental mass had decreased somewhat in size but was still rather prominent. She complained of pain and discomfort about this mass. She was readmitted to the hospital and on Jan. 25, 1949, 8 weeks after delivery of the dead fetus, the placenta was removed under spinal anesthesia. It was found to occupy most of the right lower quadrant and pelvis. The mass was easily freed from the cecum and distal portion of the ileum by blunt dissection along a cleavage plane. The cleavage plane was followed down into the pelvis where it was densely adhered to the region of the right posterolateral aspect of the fundus of the uterus and right tube. The right ovary and tube were not discernible because they were incorporated in the mass. The placenta in this region along with the right ovary and tube was finally released between clamps and bleeding was controlled with transfixion sutures of chromic catgut. The uterus and left ovary and tube were left intact. There was surprisingly little raw surface left about the cecum and distal ileum. Small fibrinous tags were removed. After hemostasis was noted to be complete the abdomen was closed.

The patient recovered uneventfully and was discharged on the seventh postoperative day. She was followed as an outpatient and was last seen on Aug. 4, 1950, in good condition. She had no complaints at that time and was having normal menstrual periods.

Case 2. E. J., a 25 year old Negro primigravida, was admitted to the Orangeburg Regional Hospital on Oct. 6, 1950, complaining of low abdominal pain. Her last menstrual period was in December 1949. On Jan. 23, 1950, she stated that she had a sudden onset of severe low abdominal pain on the left side which rapidly spread over the entire abdomen. The pain was so severe as to require complete bed rest and was followed in about 12 hours by fever, nausea, and vomiting. She does not remember being faint or extremely weak at this time. Her family physician was called and she was given "several shots" for fever. Her condition improved but for the next 3 months she had generalized abdominal pain which was predominately located in the lower quadrants. On occasions she would have exacerbations

of pain for which she received "shots". After the fourth month she had no other complaints and all the lower abdominal discomfort seemed to subside. Ten days prior to admission she had an acute onset of pain in the right lower quadrant of the abdomen which after several hours involved the entire abdomen. About 12 hours later her temperature became slightly elevated and she developed some nausea. The pain progressively became worse and she was unable to sleep. Her bowels remained normal but there was a decrease in her urinary volume. Her past history was noncontributory.

On physical examination the patient was noted to be well nourished but markedly dehydrated and apparently suffering from acute abdominal pain. Her skin was dry and her conjunctiva showed no pallor. Her lungs were clear and the heart revealed no abnormalities. Her blood pressure was 150/90. The abdomen was noted to be markedly distended and the contour was smooth. There was generalized tenderness throughout but most marked over the right lower quadrant. The fetal parts could not be outlined but the fetal heart sounds were noted in the upper left quadrant of the abdomen. Peristaltic sounds were active and there was a questionable fluid wave in the lower abdomen. The cervix was long, firm, and easily movable, and the cervical os was small. A firm mass about 15 cm. in diameter could be vaguely outlined in the right lower quadrant.

Laboratory examination revealed hemoglobin, 75 per cent total white blood cells were, 10,600 per cu. mm. with 80 per cent polys and 20 per cent lymphs. Urinalysis and Kline test were negative. Roentgenologic examination of the abdomen reported "a single pregnancy near term in transverse position. The baby is quite high in the abdomen. The appearance is that of a mass in the lower portion of the abdomen which is displacing the uterus upward".

A preoperative diagnosis of abdominal pregnancy was made. At operation on Oct. 7, 1950, the amniotic sac was found to be rather firmly attached to the anterior abdominal wall. It could be separated easily by blunt dissection and was noted to be ruptured on the right side at the level of the umbilicus. A living female infant weighing 6½ pounds was delivered without difficulty. No deformity was noted. The omentum and the intestines were adherent to the amniotic sac but were freed without difficulty. The placenta was found attached to the left fallopian tube, left broad ligament, and the left lower abdominal wall. There was no attachment to the intestines. By multiple clamping, cutting, and transfixion sutures of chromic catgut, the placental mass along with the left tube and round ligament were removed. The uterus was noted to be displaced to the right by the placenta and was enlarged to approximately 6 inches in diameter. The patient suffered immediately from postoperative shock but recovered quickly. She received 2000 cc. of blood before, during, and after surgery. Her postoperative course was normal. She was discharged from the hospital on the eighth postoperative day.

The mother and child were followed as outpatients. The baby appeared healthy. When last seen approximately 6 weeks postoperatively the mother had no complaints.

Case 3. W. M. S., a 28 year old Negro woman, was admitted to the Orangeburg Regional Hospital on Feb. 20, 1952, complaining of severe pain about the lower abdomen of 24 hour duration, accompanied by nausea and vomiting. She stated that her last menstrual period was on Oct. 18, 1951, but she stated that this did not resemble a normal period because of associated severe pain and profuse flow. Upon further questioning she stated that she had a normal period before this about the first part of September 1951. Other than this she had a normal course during pregnancy until 24 hours prior to admission. She had had 5 pregnancies; 3 children were living and well and 2 died shortly after birth. There was no history of a miscarriage. She gave a history of having had a completed treatment for syphilis 2 years previously.

On physical examination her skin was dry and there was marked pallor of her conjunctiva. Examination of the lungs and heart revealed no abnormalities. On examination of the abdomen there was marked forward protrusion of what appeared to be the uterus at the top of which was a sharp recession just above the umbilicus. This gave the impression that there was a tumor associated with the pregnancy. No fetal heart tones could be heard. Peristaltic sounds were normal. The cervix appeared to be normal but was tilted posteriorly.

On rectovaginal examination there was a significant but indefinite mass of somewhat soft consistency in the posterior culdesac.

Laboratory examination revealed a 40 per cent hemoglobin and normal white blood cell count. The urinalysis and Kline test were negative. Roentgenologic reports on Feb. 21, 1952, revealed a 6½ months pregnancy with unusual thick placental attachment posteriorly.

The patient's anemia was corrected by multiple transfusions and at operation on February 25, an abdominal pregnancy was noted with an intact amniotic sac. There were fibrinous adhesions which were easily freed from the amniotic sac intact down to the attachment of the placenta to the posterior portion of the uterus and culdesac. Apparently both ovaries and tubes, uterus, rectum, and posterior culdesac were involved in the placental mass. The amniotic sac was ruptured and a 6½ months female fetus without deformities was delivered. Both infundibulopelvic ligaments with their ovarian vessels were cut between clamps and ligated with transfixion sutures of chromic catgut. The leaves of the broad ligament on the right were carefully divulsed until the right uterine vessels were identified. The peritoneal flap in front of the lower uterus was incised and the bladder was mobilized anteriorly. The right uterine vessels were cut between clamps and ligated with transfixion sutures. Then the cervix was transected toward the left and next the left uterine vessels were identified and divided between clamps and ligated with transfixion sutures. This was followed by incision of the leaves of the left broad ligament. This left the fundus of the uterus, both tubes and ovaries attached to the placental mass which was freed by finger dissection from the posterior culdesac, care being taken not to injure the rectum. There were old blood clots under the placenta. There was some bleeding from the posterior culdesac after this mass was removed and a small block of gelfoam was tamponaded against this oozing surface by shallow sutures in the pelvis. After bleeding had been controlled the peritoneum was closed over the cervical stump. The abdomen then was closed. The fetus had died from immaturity just after the operation was terminated.

The patient had an uneventful postoperative course and was discharged on March 9, 1952. She was followed periodically as an outpatient and was last seen on March 23, 1953, at which time she was free of complaints.

Case 4. P. T., a 28 year old Negro woman, was admitted to the Orangeburg Regional Hospital on Oct. 5, 1952, complaining of right lower quadrant pain of a week's duration. She had little nausea and no vomiting. Her last menstrual period was about 6 months previous to admission, the correct date of which she did not recall. She gave a history of having pain about the right lower quadrant 2 weeks after the time when she expected her last menstrual period. This episode of pain did not last long and did not require medical attention. She was seen by her family physician for her present complaint and since she did not improve he referred her to the hospital for treatment. She had had 2 living children and no miscarriages. Her past history was noncontributory.

On physical examination she appeared to be in moderate distress complaining of pain about the right lower quadrant. Her abdomen was the size of about a 6 months pregnancy. The remaining physical examination was negative.

Laboratory examination revealed a hemoglobin of 75 per cent, total white blood cells were 16,200 per cu. mm. with 82 per cent polys and 18 per cent lymphs. The urinalysis and Kline test were negative.

The patient continued to have pain and after 2 days hospitalization it was thought that she had a normal uterine pregnancy with accompanying appendicitis. She was advised to have her appendix removed.

At operation on Oct. 7, 1952, a McBurney incision was made. Upon opening the peritoneum blood was found in the peritoneal cavity. It became apparent that this patient had an abdominal pregnancy. The McBurney incision was closed and a midline incision was made. The amniotic sac was found to be ruptured and a 6 months male fetus was delivered. The placenta was attached to the right lateral pelvic wall, fundus of the uterus, and to the right tube, ovary, and appendix. The placenta was dissected from the pelvic wall and from its attachment to the uterus. The infundibulopelvic ligament was cut between clamps and

ligated with suture ligatures. Next the mesentery of the appendix was clamped, cut and ligated. The base of the appendix was ligated and transected. The stump of the appendix was inverted with no. 000 linen purse string suture. The cornual end of the right tube and the ovarian ligament were cut between clamps, thereby freeing the placenta, right tube and ovary and the appendix all in one mass. The abdominal wall then was closed.

The fetus died shortly after the operation because of immaturity. No deformities were noted. The patient's postoperative course was uneventful and she was discharged Oct. 15, 1952. She was followed periodically for several weeks after being discharged from the hospital. A letter from her family physician 3 years later stated that she was well and healthy.

ANALYSIS OF CASES OF ABDOMINAL PREGNANCIES

It will be noted that there were no maternal deaths in this series and also that the placenta was removed in all patients. The placenta was removed primarily in 3 and secondarily in 1. Primary removal was not attempted in the first patient because of profound shock. It was amazing to note that when this placenta was removed 8 weeks later, the shrunken mass was easily "shelled away" from all its surroundings except at its attachment to the right broad ligament and fundus of the uterus.

Only one living baby was obtained. One was a full term stillbirth and the other 2, although viable at birth, died very shortly after delivery because of

TABLE I

Analysis of cases of abdominal pregnancy

	Case 1	Case 2	Case 3	Case 4
Gestation	9 mo.	9 mo.	6½ mo.	6 mo.
Race	Negro	Negro	Negro	Negro
Gravida	4	1	6	3
Maternal Survival	Yes	Yes	Yes	Yes
Maternal Complications	None	None	None	None
Fetal Survival	Stillbirth	Yes	Died (immaturity)	Died (immaturity)
Management of Placenta	Removed Secondarily	Removed Primarily	Removed Primarily	Removed Primarily
Preoperative Diagnosis	Transverse Position, Uterine Inertia, Dead Fetus	Abdominal Pregnancy	Abdominal Pregnancy	Acute Appendicitis and Pregnancy
First Trimester "Symptoms"	None	Yes	Yes	Yes
Position of Fetus by Roentgenogram	Transverse Position	Transverse Position	Transverse Position	None taken
Deformities of Fetus	None	None	None	None
Detachment of Placenta with Bleeding	None	None	Yes	Yes

immaturity. All patients were Negroes and this seemed to be in accord with other reported series. Since pelvic inflammatory disease is higher in the Negro race, it is speculated that this plays an etiologic factor. The postoperative morbidity in the patients in whom the placenta was removed primarily was no greater than an average pelvic operation.

In 3 of these patients there were definite symptoms of tubal rupture or tubal abortion. These symptoms apparently were not associated with the profound shock which would lead to operative intervention. The other could not recall any symptoms, but at operation it was densely adhered to the right tube and ovary.

The diagnosis of abdominal pregnancy was made in 2 cases. The first case was unexpected and in retrospect may have been diagnosed if a reasonable degree of suspicion was made. It will be noted that in the 3 patients who had roentgenograms, all showed the fetus in transverse position. The last patient had all of the symptoms and findings of acute appendicitis with concurrent pregnancy of 6 months; no roentgenogram was taken.

Fetal anomalies are said to be more common in abdominal pregnancy. In our small series none were found. Hemorrhage is not an uncommon complication of abdominal pregnancy and apparently is due to the progressively enlarging placenta which becomes partially detached with ensuing hemorrhage. This was noted in 2 patients.

In all of these patients there was no indication for delay in operation. Because of the dangers to the mother operative intervention is recommended as soon as the diagnosis is made.

SUMMARY

Four cases of abdominal pregnancy are presented. There were no maternal deaths and all placentas were removed, 3 primarily and 1 secondarily. From this group 1 living baby was obtained, 1 was a stillbirth and 2 died shortly after operation because of immaturity. Removal of the placenta is recommended when feasible. Some observations in the management of the placenta are recorded.

1. Broomes, E. L. C.: Full term abdominal pregnancy with delivery of a living child, J.A.M.A., *145:* 399 (Feb. 10) 1951.
2. Cross, J. B., Lester, W. M., and McCain, J. R.: Diagnosis and management of abdominal pregnancy, Am. J. Obst. & Gynec., *62:* 303 (Aug.) 1951.
3. MacGregor, A. S.: Abdominal pregnancy, Am. J. Surg., *82:* 365 (Sept.) 1951.

Orangeburg, S. C.

EDITORIAL

CARELESS ANESTHESIA AS A HAZARD TO THE SUTURE LINE

In abdominal surgery (including the surgery of hernias), performed under general anesthesia, the most crucial time for the patient so far as the anesthesia is concerned is the time between the moment the anesthetic is stopped and the time the patient regains consciousness. During this period of time every effort should be made and every consideration given to prevent struggling. Every surgeon of experience is familiar with the disastrous effects of struggling on the suture line. During the course of operations, I have seen strong sutures which had been placed in abdominal fascia break with a loud report when the patient's anesthetic was allowed to become too light and he was allowed to struggle. After the wound is closed and the patient struggles, it is impossible to know whether his struggling has caused the rupture of important suture lines or not.

How then is this unfortunate occurrence to be avoided? Two very simple things are suggested: First, that the anesthetist refrain from sucking out the trachea when the patient is under light anesthesia; and, second, that the patient be given a narcotic as soon as he shows any evidence of struggling or any violent movements.

I believe that the practice of sucking out the trachea is very much overdone. Many anesthetists do this as a routine at the end of the operation whether it is needed or not. If the patient has had atropine preoperatively and shows little evidence of moisture in the trachea, there is no reason for the procedure. If there is reason for it, it should be carried out with the patient under deep enough anesthesia so that he will not struggle and break suture lines. Furthermore, it should be pointed out that the mucus that causes atelectasis and other respiratory difficulties is much lower down and far beyond the point where it can be reached by suction. In view of this, some anesthetists use suction as a cough-provoking mechanism. That is fine theoretically but often while they are trying to produce an innocuous cough, they produce violent struggling which is disastrous to the suture line. It should be kept in mind that the sole object of the patient's journey to the operating room is to cure him of the condition for which he is being operated upon. It also should be remembered that anesthesia is not an end in itself but an aid to the therapeutic procedure of the surgeon. It is much better to allow the patient to retain some of his mucus until he can get rid of it when he is thoroughly awake, than to run the risk of causing violent struggling which will undo the whole (in hernias) or a part (in wound disruption) of the surgical procedure. There are certain calculated risks which go with every surgical procedure, and it must be kept in mind that it is better to risk a certain amount of mucus in the bronchial tree than to run the risk of nullifying the efforts of the surgeon in curing the condition for which the patient came to the operating room.

A narcotic should be kept ready to give the patient as soon as he shows any

evidence of struggling or other violent movements. Some patients, during the course of regaining consciousness, suddenly start unlooked-for struggling. An ample dose of a narcotic generally will stop this immediately. It is well to find out ahead of time whether the patient has an idiosyncrasy to any narcotic. It is well known that morphia excites some people, but there are many other narcotics that may be used. It is true that narcosis depresses respiration, but that is another of the calculated risks that goes with the carrying out of a surgical procedure to its full fruition. If the patient is not given narcotics preoperatively (but only hypnotics), the postoperative narcotic will not cause so much depression of the respiration. A narcotic in a liberal dose postoperatively will allow the patient to sleep his anesthetic off rather than struggle it off, and that is very important from the point of view of the operative wound. Often very little narcosis is needed after this first dose. It is the first dose that is important because it protects the patient from doing serious damage to his wound while he is unconscious. Once he regains consciousness, the pain of movement will keep him from doing anything that will damage his suture line.

Anesthesiology as a full blown specialty is fairly young. There are certain little kinks in it which need ironing out. That is the reason for this discussion. Surgery is an intricate procedure requiring highly coordinated teamwork on the part of the surgeon, the anesthetist, the house staff, nurses and orderlies. A break in teamwork on the part of any member of the team may be disastrous for the patient. Certainly the closest teamwork is required between the surgeon and the anesthetist and happily in most instances that is cheerfully accomplished. For both of them the welfare of the patient must come first. The type of anesthetic best suited to the patient should be discussed between them before operation. The progress of the operation and the condition of the patient should be subjects of frequent discussion during the operation. Towards the end of the operation the condition of the patient and the depth of the anesthesia should be freely discussed. Certainly the anesthetist should do nothing to the patient to cause struggling without first discussing the matter with the surgeon. The surgeon should know something of the depth of the anesthesia when the operation is concluded, so he can estimate how soon a narcotic will be needed in order to prevent struggling. It should be remembered that surgical anesthesia is an adjunct to surgery and not an end in itself. Our best anesthesiologists are well aware of this and are doing all they can to train the younger men along the same lines.

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BOOK REVIEWS

The Editors of THE AMERICAN SURGEON *will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The Editors do not, however, agree to review all books that have been submitted without solicitation.*

Diagnosis and Treatment of Vascular Disease (Angiology). By SAUL S. SAMUELS, A.M., M.D., F.A.C.A., F.A.C.C., Chief, Dept. of Peripheral Arterial Diseases, Stuyvesant Polyclinic Hospital, New York. 621 pages, illustrated. Baltimore: The Williams and Wilkins Company, 1956. Price $16.00.

"Diagnosis and Treatment of Vascular Disease (Angiology)" is a product of 17 contributors with Saul S. Samuels as Editor-in-Chief.

The purpose of the volume, as expressed by Dr. Samuels in the preface, is to organize the various aspects of vascular disease, surgical and medical, into a specialty field, "Angiology". The approach is not unique, the various diseases and their diagnoses and treatments being discussed in sections authored by one or more of the contributors.

The general coverage is comprehensive, including detailed chapters of the anatomy and innervation of peripheral blood vessels, and a short section on medical legal aspects, as well as the usual subjects covered in this field. The Editor explains omission of description of sympathectomy on the basis of available descriptions elsewhere. However, for completeness the surgeon might feel it well to have included this subject.

In general the material is presented in a very readable and concise manner. While there is limited detail in some areas, the book is exceptionally well footnoted for specific references. This has the advantage of providing material in a fashion which can be readily covered and yet have specific reference to more detail. To the reviewer, the subtitle in some of the chapters could be revised to allow for easier reference (for example, in the section on "Thrombosis and Embolism", the subtitles do not clearly indicate the discussion of arterial disease and venous disease).

Illustrations are good, particularly the section on "Angiology". The surgeon might desire more illustrations of some of the surgical procedures described.

This book can unhesitatingly be recommended for the general practitioner and general surgeon, as well as the "angiologist".

JOHN P. WILSON, M.D.

Scalpel—Men Who Made Surgery. By AGATHA YOUNG, 301 pages, cloth binding, 457 Madison Avenue, New York 22, N. Y. Random House, Publishers, 1956. Price $5.00.

The author has spent some four years in research in various medical centers in America and Europe, finding small intimate details in the lives of a few of the Fathers of modern surgery. She has visited most, if not all, of the localities in which these men lived and worked. She has read their papers and letters. In this manner, she has been able to dig up the small things and incidents in the lives of these men so that she could portray them in a human manner, telling of their likes and dislikes, their peculiarities and idiosyncrasies. Because of this after one has read the book, one feels that he has known these characters, not as persons placed on a high pedestal but as human beings, working and struggling for something they feel worthwhile.

The style is easily readable. The print and paper are acceptable.

This book should find favor among the surgeons and physicians of the English speaking world as a group of short biographical sketches of great men.

A. H. LETTON, M.D.

Transactions of American Goiter Association, 1955. 469 pages, illustrated, cloth binding, Springfield, Illinois. Charles C. Thomas, Publisher. Price not stated.

This is the printed form of all the papers read before the American Goiter Association in Oklahoma City, Oklahoma, in May of 1955. Many of these papers have been printed in the Journal of Clinical Endocrinology.

These papers represent a very find cross-section of the research, as well as the clinical aspect of the physiology and pathology of the thyroid gland. Some of these papers are highly technical and are understandable only by those familiar with the research problems involved. Other papers are purely clinical. All are of value to the thyroidologist.

The printing, paper, and binding are good. This book should be in the possession of all those interested in the diseases of the thyroid for it contains so much of interest, and in the future it will serve splendidly as a reference.

A. H. LETTON, M.D.

BOOKS RECEIVED

Books received are acknowledged in this section, and such acknowledgement must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Plastic Repair of Genito-Urinary Defects. GEORGE BANKHOFF, M.D., D.Ch., F.R.C.S. Ed., F.R.F.P.S., Honorary Surgeon, Italian Hospital, London, Formerly Associate Professor of Surgery (Plastic and Reconstructive Surgery), Georgetown University Medical School, Washington, D. C., Plastic Surgeon, Gallinger Municipal Hospital, Washington, D. C., Formerly E.M.S. Surgeon, St. John and St. Elizabeth Hospital, London, Assistant Surgeon, University Hospital, Bonn, Honorary Surgeon, St. Joseph's Hospital, Manchester, Chief Surgeon, Plastic Department, George Eastman Institute, Rome. New York City, Philosophical Library, Inc. 1956. $17.50.

Fluid Balance Handbook for Practitioners. WM. D. SNIVELY, JR., M.D., Member, American Academy of General Practice, Attending Physician, Evansville Child Health Clinics, Staff Member, St. Mary's Hospital, Medical Department, Mead Johnson & Company and M. J. Sweeney, M.D., Member, American Academy of Pediatrics, Attending Physician, Evansville Child Health Clinics, Staff Member, St. Mary's Hospital, Medical Department, Mead Johnson & Company. Springfield, Illinois, Charles C Thomas, 1956. $6.75.

Corneal Grafts. Edited by B. W. RYCROFT, O.B.E., M.D., D.O.M.S., F.R.C.S. (Eng.) with a foreword by Sir Cecil Wakeley, K.B.E., C.B., LL.D., F.R.S.E., D.Sc., F.R.C.S. (Eng.), F.R.A.C.S., F.A.C.S., Hon. F.R.C.S. (Ed.), London, England, Butterworth & Co., Ltd., St. Louis, Missouri, The C. V. Mosby Company, 1955. $13.50.

A Manual of Anesthetic Technique. WM. J. PRYOR, M.B., Ch.B. (N.Z.), F.F.A.R.C.S. (Eng.), D.A. (Eng.), M.F.A., R.A.C.S., Anesthetist, Thoracic Unit, Christchurch Hospital (N.Z.) and Late Anesthetic Registrar, The London and Poplar Hospitals, London, with a foreword by J. H. T. Challis, M.R.C.S. (Eng.), L.R.C.P. (Lond.), F.F.A.R.C.S. (Eng.), D.A. (Eng.), Senior Anesthetist, The London Hospital, Baltimore, The Williams & Wilkins Co., 1956. $7.00.

Anatomy for Surgeons, Volume 2. The Thorax, Abdomen, and Pelvis. W. HENRY HOLLINSHEAD, Ph.D., Professor of Anatomy, Mayo Foundation, University of Minnesota, Head of the Section of Anatomy, Mayo Clinic, Rochester, Minnesota. New York City, Paul B. Hoeber, Inc., 1956. $20.00.

Principles and Methods of Sterilization. JOHN J. PERKINS, M.S., Director of Research, American Sterilizer Company, Erie, Pennsylvania. Springfield, Illinois, Charles C Thomas, 1956. $8.00.

Clinical Urology. Volumes 1 & 2. Third Edition. OSWALD SWINNEY LOWSLEY, M.D., Thomas Joseph Kirwin, M.D., illustrated by William P. Didusch. Baltimore, Maryland, The Williams & Wilkins Company. $32.50.